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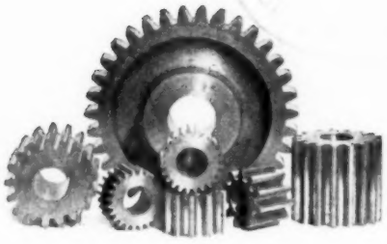

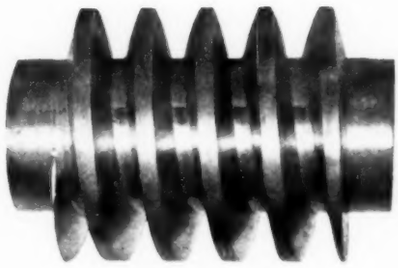

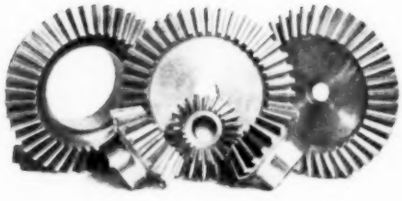

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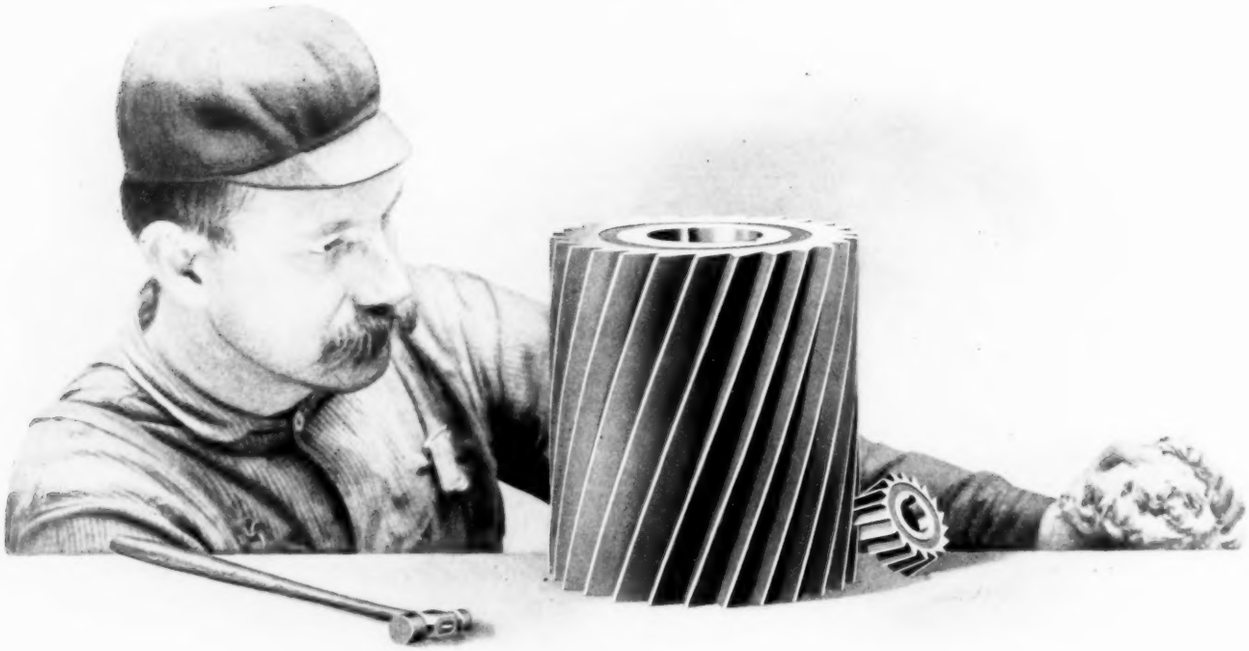

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Some More Points About Grinding.

BY C. H. NORTON.

Tecumseh Swift and F. Thornley at pages 345 and 353 have shown an interest in what I have said about grinding, and I wish to thank them most sincerely. It was to provoke some interest in what I know to be an important machining process that I wrote the article referred to, and it certainly gives me pleasure to know that what I said did not meet with the customary reception, "It can't be done."

Mr. Swift says that I am under obligations to write "What I Know About Grinding." Now, I shall have to plead ignorance when it comes to that, for the subject is growing so rapidly with every day's experience, that I prefer to call it "More Points About Grinding," and if more points will bring out more interest and more discussion I shall be willing to give them, for the points will always be ready as fast as we are ready to digest them. The field for study is in my opinion larger than any other field machine builders have ever entered. We have lost many valuable years, but by what has recently been accomplished the field is thrown wide open for study and work.

I had not presumed to tell how to grind, but to call attention to the fact that grinding had been misunderstood, and to draw out interest by telling things that are absurd, yet are so common. These absurd things are common because we have blindly followed our "grandads" and our prejudices. Now, let us go at the problem in a businesslike way, and if what I have said will start, as Mr. Thornley says, a "profitable discussion," I shall have been well repaid.

Mr. Swift says he has learned that a cubic inch of steel per minute can be removed by grinding. He says also that this is a surprise to most mechanics. I am aware that it is; but really why should it be a surprise? Why is there anything more astonishing about this than the statements about the removal of metal with the newer, heavier lathes and high speed steels? In the latter case we are not astonished because we clearly understand that the results are due to suitably designed machines and superior cutting steel. We know we can remove steel by turning just in proportion to the weight and convenience of the lathe, amount of power used and the quality of the cutting steel. Why should we not use the same reasoning with grinding? Commercial grinding is not light work, and heavy, convenient machines and rapid cutting wheels will remove stock rapidly for the same reason that heavy and convenient lathes and the best quality of cutting steels will turn rapidly.

Imagine a manufacturer, after hearing the story of the possibilities of the rapid reduction lathe, as demonstrated by the Bullard and Lodge & Shipley machines, deciding to demonstrate the truth of these stories by buying a lathe with half the power at half the price. Of course you would laugh at him. But this is just the way we have been doing with grinding. We have been "rigging up" our old lathes and buying grinding machines suitable to grind work very small because they would just swing our largest piece. We never use this reasoning when dealing with profitable turning; we know better.

Many times I have met intelligent manufacturers who have said they were now grinding their work, and have shown me with pride their grinding machine, which was really a lathe so old it might have belonged to their grandfather, and on the carriage was mounted a wheel so small, and of so inferior material, that, compared with the work it was to do, it was like placing the new rapid cutting steels in a little 10-inch lathe made twenty-five years ago, and attempting to compete with the modern rapid-reduction lathes in removing stock rapidly. In the opinion of the writer, grinding will not stop at 1 cubic inch per minute, but will go on and on as the trade is ready to receive it, until a sizing cut representing many cubic inches will be ground in a minute.

I trust I may be pardoned for introducing a bit of personal experience, for it is in line. Years ago I believed that grinding could be made to reduce the time of sizing as well as finishing work, but in spite of all efforts to do so, could not get the opportunity to demonstrate it by a working machine. I have long believed it feasible to restore worn piston rods for locomotives and all similar work without turning in lathes, but all with whom I consulted assured me that such a proposition was absurd. Time has intervened, and I have recently had the pleasure of seeing a workman at one of the prominent railway repair shops grind piston rods for repairs without any turning; the actual time of grinding being eight minutes each. The lathe work time has been 1½ hours for the same job, not so well done. Some idea of why it was possible to grind these rods in such short time may be obtained when we realize there were 13,500,000 cutting points in contact with the work every minute, and that the machine was heavy and powerful.

Mr. Swift asks the usual question: "How about grinding up into the corners or against the shoulders?" This is the question the grinding machine man has to answer first of all, and to one experienced in grinding this seems the strangest question of all; it is like asking a file dealer how he is going to file a round shaft up near the shoulders. The answer to Mr. Swift's question is simply this: The shoulders are all made by the lathe and finished to the right length and position. Usually this is done before grinding, but many times it is better to complete the shoulders after grinding. The grinding wheel grinds the cylindrical portion clear *to* the shoulder.

Is the movement of the grinding machine when reversing accurate enough to just touch the shoulder at every stroke? No, most certainly not, and this is no more necessary than it is for the lathe to turn a shoulder in the right place without the aid of the operator. The professional toolmaker, when operating a grinding machine, spends much of his talent in trying to accomplish this feat, but the practical grinding machine operator sets the machine to reverse a short distance from the shoulder, then at the proper time during the operation moves the table by the handwheel and carefully trims the stock clear to the shoulder, and, when necessary, by this means can true the shoulder up also.

Where work is turned (and it always is, of course, when there are shoulders) it is unnecessary to leave over 1-32 inch diameter to be ground off; in which case it is just as simple to grind the cylindrical size clear to the shoulder, leaving a corner of not larger radius than is usual, as it is to turn the same with a tool; but a good way to defeat the introduction of grinding is to insist upon having a sharp, razor corner left in the shoulder, and then prepare the work by leaving all the material in the shoulder you can; this will defeat it, for the grinding machine man will leave you in disgust, as he should. It is easy to grind in a sharp cornered shoulder with a wheel made for that purpose. We all know, however, that sharp corners are not necessary in these times, and rapid grinding can be done with a wheel that will leave a fillet of very small radius when removing only 1-32 inch from the diameter. If for any reason it is necessary to have a sharp shoulder, it is better to make it so in the lathe. It is not necessary to "neck down" for shoulders, but it is necessary to make them in the right place with the lathe. The grinding machine is not a forming machine; the lathe must do that work.

When a visitor at our works wishes to know what can be done in the way of "necking in" with the grinding wheel alone, we show him a model. This model is convincing proof that it is possible to cut in any depth with the emery wheel creating the shoulder. It is not, however, practical in my opinion, except in some unusual case. The lathe is still the proper roughing and forming machine; but the grinding machine is now the proper *sizing* and *finishing* machine for *all* cylindrical work, whether it is to be *accurate* or *inaccurate*, *well finished* or *rough finished*.

Mr. Swift says he has learned that emery does not adhere to the surface ground. He tells of his early experience rubbing valve seats to fit by putting loose emery between the surfaces and forcing the emery into the metal. I remember doing this same thing years ago and somehow it seems perfectly natural that the emery should imbed in the metal, but it never did seem possible or natural to me that

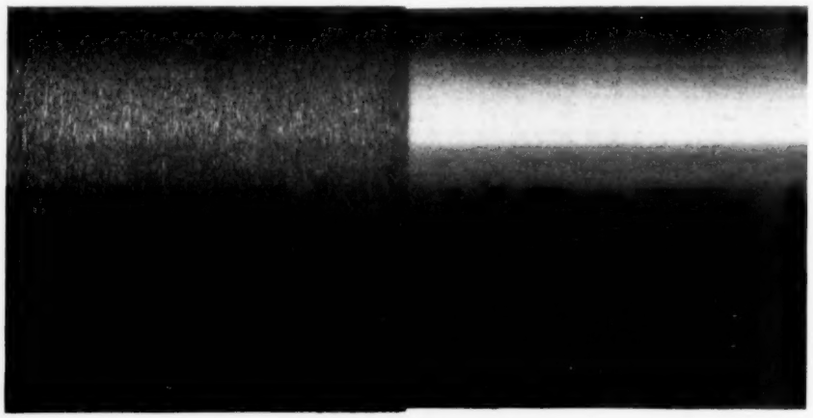
emery from a rotating wheel could be imbedded in the work being ground. Suppose we take a milling cutter and break off little pieces of the teeth and jam them between two flat surfaces, we should expect them to adhere, but we do not expect pieces of the cutter to adhere to the work it is milling. Did this ever happen? The writer never heard of such a thing. If such a thing could happen we know that the contact with the broken teeth would tear away our cutter and it would cease to cut; but this not the action of the milling cutter. We all understand that in doing its work the cutting edges gradually wear away until they become quite dull, yet no particle of the cutter teeth adheres to the surface they have milled. I think all will agree with me that adhesion of the cutter to any extent would prevent cutting the steel. If you can imagine a milling cutter so soft that it can be made to imbed in any way in the surface it is rubbing against, you can also imagine very easily that it would not cut. We must use the same reasoning with emery wheels as we do with milling cutters, for the emery wheel is certainly a milling cutter made up wholly of teeth that cut upon many sides, and are held together by a bond which wears more or less according to the design of the wheel, allowing these teeth to cut more or less deeply, but these teeth are used in all modern grinding until they are probably wholly worn away; that is, our milling cutter gradually wears away whether it is made of emery or steel, and does not adhere to the steel for the same reason that the material that wears off from the milling cutter does not. Even when we have a wheel so soft that its particles are torn out bodily by contact with the work, there is still no adhesion of the emery to the work. Such wheels, however, are rarely used to-day; that is they would be used on hard material when the particles would not be torn out bodily by the work.

When the bond of the wheel is too hard (that is for the work in hand), when it will not wear at all or at least very slowly, and this wheel is revolved at too slow a speed and the revolving work forced against it very hard, the steel will sometimes adhere to the wheel, making a covering over the entire face. We all understand this in connection with grinding babbitt. Now imagine the particles of an emery wheel adhering to the work. In a moment's time we would have a round piece of steel covered with emery, and we would not require a magnifying glass to find it.

Very long work is ground perfectly straight, the wheel not wearing even the one-hundredth part of one-thousandth from the diameter during the light or finishing cut. Please realize this. How can any of the wheel adhere if it does not wear? and how can it grind straight if it does wear?

There is a popular notion that long work cannot be ground straight with a grinding wheel because the wheel wears. This is one thing I am willing to say I do know. I do know that the wheels I use do not wear at all on the finish cuts, and if I wish it so, very little on other cuts. Under certain conditions the wheel can be made to work for hours without losing more than a few thousandths from its diameter, and when it is desirable the wheel can be made to duplicate the diameters of several pieces at one setting. The simple matter of wear of the wheel, when that is the only matter of consideration, is easily controlled. If there is anyone who cannot do this he needs to look into the art deeper. It is possible to so vary the speeds of work and wheel that a large amount of stock can be removed with a very small wear of wheel. It is also very common among grinding machine operators to so arrange the speed of work that a really good wheel will be worn away rapidly, yet without accomplishing so much work per hour as the wheel is capable of producing.

Now that was the way of grinding for many years. We never did use water, so we never did. Now we do, and we find the cutting points of the wheel remain sharp very much longer than when dry, and of course the work is not distorted by the heat. For a great many years we used the diamond tool dry, and someone paid for more diamonds, for they wore out rapidly. Now we arrange for a heavy flow of water covering the entire face of the wheel while using the diamond. The result is, less than half the number of diamonds are required to-day. The diamond is softer when hot than when cold, so are the little rubies and sapphires of which the wheel is made. Just in proportion as we keep down the temperature will the endurance of these particles be increased. We use water now mixed with lubricant to reduce the friction and still further keep down the temperature. We formerly thought without friction there could be no grinding; now some of us believe that grinding is simply cutting, and that the heat seen is due simply to the



DIFFERENT SURFACES GROUND BY THE SAME WHEEL.

The older methods of grinding (and many adhere to them now) call for a work speed of not less than 100 feet per minute and sometimes more; this condition makes it almost impossible to remove a large amount of metal without excessive wear of wheel. The later method calls for a work speed ranging from 10 feet per minute to 40, according to the material and rigidity of the work being ground, the depth of the cut desired and the kind of surface, whether rough, medium or smooth.

Yes, we use water for grinding. We would not think of using a milling cutter dry on certain work, while on other work it is used dry and consequently hot.

Did you ever try a large amount of soda water flowing (not dropping) on cutters while milling cast iron? I mean a large amount of water; not just enough to make the work sticky, but plenty. I have, and they stood up and cut faster than I ever saw them do dry; but you "never did" use soda water when milling cast iron, so you never do.

fact that the cutting is done so rapidly. As we increase the amount of cooling lubricant the sparks become less brilliant for a given amount of material removed. An operator who is accustomed to dry grinding usually makes the wet work too small until he becomes used to the spark color.

Mr. Swift speaks of the particulars to be considered in determining how best to do an individual job of grinding, etc., and he gives the impression that the matter is very complicated, and in fact he says there is "a wide range of variation; the combinations possible are practically infinite." I cannot agree with him here, for while the conditions may seem puzzling to the novice, the whole matter is really very simple, and the combinations are very far from infinite. He says the range of materials to be worked on would be perhaps the least numerous of any of the details to be considered. This matter of material is perhaps the most important of all.

While a passable job of grinding can be done alike with open hearth, Bessemer,

crucible and tool steel, with the same wheel, without taking note of the amount of carbon in the different pieces, yet if one were to do grinding of these pieces in large lots and the matter of economy of time and economy of wheel were well cared for, each variety of steel would require a different wheel, and each considerable change of carbon would also necessitate different wheels—that is if the grinding were done by the older methods and on light machines. The later method and machines make possible economical grinding of all these varieties of steel, having different amounts of carbon, with from three to five different wheels. This is partly due to improvements in the wheels themselves, but also to heavier machines and to the modern method which accomplishes this by means of the large range of work speed, work traverse and depth of cut provided for.

This matter of work rotation is very important; *i. e.*, the range of speed for any given diameter, for the speed of work rotation does not depend upon diameter wholly; the different steels and grades of carbons requiring different surface speeds to obtain the desired effect with a given wheel. The piece of work I send to the AMERICAN MACHINIST office illustrates this; the coarse surface was obtained with one speed and the fine surface with a considerably slower speed and a shallower cut.

The range of work speed for any one diameter of work is growing greater with experience. Formerly the range of speed for work was simply to give about the same surface speed for all diameters that were ground in the machine. Now the latest machines are arranged to utilize the entire speed range for any diameter, and this in some cases as great as from 10 to 50 feet of surface per minute. This great range of work speed enables the operator to make one wheel grind many different steels, and also to produce either a coarse or fine surface, as required. It is very important that the machine of to-day be so arranged that the operator can instantly change the speed of his work, for it is most desirable that he use more than one speed for different pieces of the same diameter and same material. This he does to obtain the results required, and he determines the speed in each case by the results; all this is determined in a moment, without delaying the work—in fact, is done while the work is going on, so that the diameter has very little to do with the speed of rotation.

We do not feed the milling machine table past the cutter according to the *length* of the work, but rather according to the "way the cutter acts." We note the result and change the feed of table and depth of cut to suit the cutter. When grinding with a modern machine we think of our revolving work as passing our cutter, and change the surface speed to suit.

As to the kind and texture of the cement of which wheels are made, neither Mr. Swift nor the writer will need to know anything in order to understand grinding. One should know, however, a few facts about the hard and soft wheels, as related to the different sizes of grain. This knowledge is very easily acquired, but cannot be explained in an article like this, as it should be.

To do plain external grinding there are very few shops that would require more than three wheels for grinding cast iron, hardened steel, tool steel, crucible steel and soft steel. The various bronzes and brasses require a slight change of wheel for each different alloy. No one can safely recommend a wheel for grinding any of the alloys. Nothing but experiment with each one can determine.

I believe that there is no way to instruct Mr. Swift or others except by personal interview combined with a few weeks' practice with a modern grinding machine. There are some facts, however, which can be dwelt upon with profit in these columns, and discussion is one way to bring them out.

Referring to the letter of Mr. Thornley: I have no practical knowledge of grinding chilled rolls for flour mills, but believe, that with modern machines and wheels the grinding of such rolls need not be at all difficult. Mr. Thornley says it is hardly fair to say that the main fault in the grinding business rests with the users rather than the makers—of wheels. In this connection it may be interesting for him to learn that grinding wheel makers usually are obliged to furnish a different wheel for nearly every customer who grinds chilled rolls. If they recommend a wheel that is giving satisfaction in a certain place, another party often declares the same wheel unfit, although he may be grinding chilled rolls of the same size for the same purpose. It is probably true that no less than twenty-five different grades and grains of wheel have been used for grinding accurate chilled rolls. Mr. Thornley may understand the reason for this when he learns that it is possible to obtain several different grains of cut by one and the same wheel in the same machine. I find it quite easy to produce a very rough finish, also a fine finish with the same wheel by varying the speed of work, work traverse and depth of cut. No less than half a dozen results may be produced by this means. It would be very difficult for grinding wheel makers to recommend a wheel for certain work, when each one of their customers doing that work was using a different wheel. The piece of work I send to the AMERICAN MACHINIST office will show how it is possible for grinders to pronounce the wheel that ground it either good or bad The one who happened to have a machine so arranged as regards work-speed, wheel-speed and work-traverse to suit this wheel would call it a good one, while another having a different machine and different notions about its use, would call it "too coarse."

Mr. Thornley says "roll grinders are born, not made." Well, perhaps they are in the sense that all are born with different capacity for reasoning from cause to effect. Here is a case in point. A grinding machine was purchased by a manufacturing concern where men had been grinding nice work for years; these men were in a sense born to this particular work; they were "experts." The new machine was pronounced a failure, and at once the experts were set to work to alter it to suit them, but ere long the makers insisted upon the fact that the machine, as originally made, would produce much more and better work when operated by a bright boy who had no experience, than the old ones did when operated by the experts, and it proved to be true; the makers dictating where each belt and feed should be used, also the wheel and how it should be used. The experts could not succeed; it required a man bright enough to understand that the designer of the machine understood it better than he did, and to succeed he must do just what he was told to do. Neither the designer nor the operator were experts at that particular work, but the machine and wheel obeyed the laws for which they were designed, and all that was necessary to do was for the designer to arrange for the machine and wheel to be allowed to act. It may be interesting to know that in this case the designer was several hundred miles from this machine when he dictated how the work should be done.

When the grinder has to grind with many of the machines that are in use he certainly must be expert; for as a rule his machine obeys any law except those that would give a straight, round and smooth roll. I am aware that this statement will cause surprise and comment, but time will certainly prove it to be correct. Suppose we were to attempt to turn straight and uniform work on the old hand tool lathes of our grandfathers. I suspect we would be on the hunt for men who were "born turners," for we would be very slow in making them. I once worked where there was a lathe that had been in a fire, and to get straight work we had to move the tool forward and back constantly. The spindle also was not round, and one had to file off the high spots on the work. Now many of the machines for accurate grinding have wheels so small in proportion to the work they are to do, that nothing but a lifetime's practice will enable an operator to get straight work. Others have supports for wheels so weak, that should the work be a little larger at one end than the other before grinding, it will surely be so when ground, unless the operator plays some trick of the trade to overcome it. None but he who has lived with his machine can know how to overcome its whims. We see rolls 12 to 16 inches diameter and 8 feet long ground with wheels

14 inches diameter by 1 inch thick. The wonder is that the roll is ever completed or that it is ever correct.

I cannot but look upon the man who grinds such rolls correctly under those conditions with profound admiration, for he certainly is skilled in his art—especially when we realize that his wheels are held by a skeleton frame work that can be pushed aside from the line of truth very easily. We can only wonder that he can get straight work when we know that his wheels should be mounted and held to an anvil whose weight is equal to or greater than the weight of the roll he is grinding. The law is the same whether we turn or grind—we must have cutting tools in proportion to the amount and quality of the work done.

Mr. Swift asks just how a certain job was done. It would be difficult to tell this in these columns, but, in short, it was accomplished with a heavy, powerful machine and a most excellent wheel, driven by sufficient power.

What is needed to-day is, that all come to know the truth of these words: Grinding is *not* light work.

A New Opening Die.

The accompanying engravings illustrate a recently designed opening die, intended for turret lathe work, and possessing a number of novel and interesting features. The chasers in this die are positively opened by the rotating stock itself; the mechanism controlling the chaser is so arranged that the operator may take two or more cuts if desired in finishing the thread, the depth of roughing and finishing cuts being easily regulated to suit the diameter and nature of the work, while the size of the finished piece is varied at will; the shank, though engaging with the chaser head during the threading operation, is detachable and the die may therefore be used in different sizes of turrets by simply changing shanks.

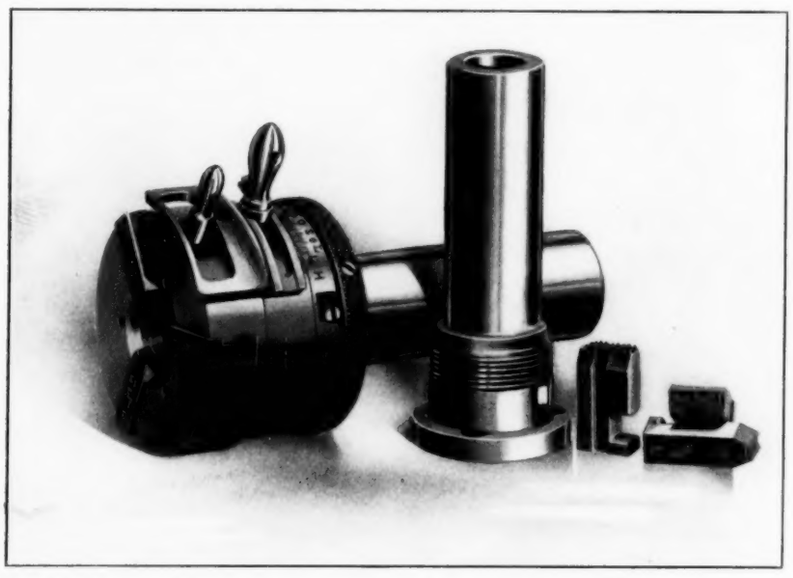


FIG. 1. A NEW OPENING DIE.

The half-tone, Fig. 1, gives a clear idea of the appearance of the assembled die, the removable shank and chasers; and the line engraving, Fig. 2, shows its construction.

Referring to the latter engraving it will be observed that the head *a* for the chasers is provided with a body fitting freely the bore of the cam *b*, a hollow hub formed at the rear entering the front end of the hollow shank *c*. This shank has at its inner end a flange which bears against a shoulder formed in the bore of the cam, the shank being slipped in from the front. Directly back of the cam is mounted a ring *d*, which is splined to suit a pin in the shank, and behind this is placed a threaded and knurled collar *e*, this being adjusted and then locked, by a screw, in such a position on the threaded portion of the shank that the cam may turn, as far as required, upon the latter. The amount the cam may rotate is limited by two stop screws *f* tapped into *d*, as shown, and entering a slot in this ring, which a pin *g* driven in the cam also enters. In the back of *a* three pins are fitted; one of these is shown at *h* in the sectional view. The pins enter steel bushings in the shank and prevent the head from rotating while feeding up on the work. The front of the cam is three-sided, as indicated by the dotted lines in the plan, and the cam surface, which is really a ledge or wall projecting beyond the front of the body,

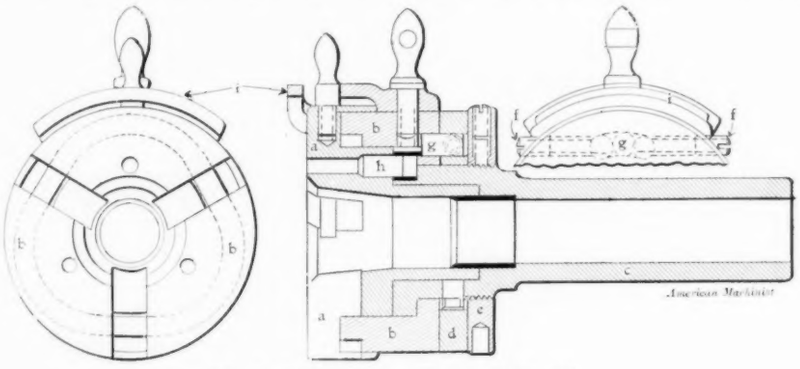


FIG. 2. SHOWING CONSTRUCTION OF DIE.

enters the slots milled in the backs of the chasers. When the die runs upon the work and the turret slide reaches the end of its travel, the head *a* draws away from the shank *c* until the three pins are drawn from their bushings; the hub still rotating with the chasers in the thread turns the head and chasers, and the cam remaining stationary the die opens and is then drawn away from the threaded piece. To close the die again *a* is pressed back and turned slightly or until the driving pins enter their bushings.

It will be seen that by turning the cam *b* upon the shank the depth of the cut may be varied as desired. To facilitate the setting of the cam, the ring *d*—which, as already noted, is keyed fast to the shank—is graduated, as indicated in the half-tone, a zero line is scribed on the cam, and a small handle is screwed in the cam by which it may be moved so that its line will coincide with any line on the ring. The graduations are for both right and left hand threads; two zero lines will be noticed in the series, one of these being the setting point for cutting a standard size right-hand and the other for a standard size left-hand thread. A setting between *o* and the outside line at either end of the series of graduations will give a thread above standard size, while a setting in the opposite direction—or toward the central division of the series—will cause the chasers to cut smaller than standard; the letters stamped on the ring indicating clearly the direction in which the operator must turn the cam to obtain the desired result. The stop screws *f* (both of which are shown in the half-tone) are adjusted as required and used for positioning the cam for roughing and finishing cuts. If a right-hand thread is to be cut, and in one operation, the cam is brought against the forward stop screw; if roughing and finishing cuts are required the cam is turned toward the back

until stopped by the rear screw and the first cut is taken; the cam is then turned toward the front and against the other stop screw for the finishing cut. For left-hand threads the movement of the cam is, of course, reversed. If, for any reason, more than two cuts are to be taken on the thread, the cam may be set at any point between the two stops; thus the threading operation can be divided up in any desired manner. The cam requires no locking or clamping device to hold it either against the stops or when set in any intermediate position, as the pressure of the chasers, when these are in operation, is practically perpendicular, to the opposing surfaces of the cam, and there is therefore no tendency for the latter to rotate on the shank.

The distance the chasers are opened by the rotating work when the three pins at the back draw out of the bushings in the shank is regulated by the curved plate *i*. This, as shown more clearly in Fig. 1, is adjustable, it being slotted at the back for the threaded end of the cam regulating handle or pin, by which it is clamped fast to the cam, while at the front is another slot through which passes a pin secured in the chaser holder or head. The plate thus forms a stop to prevent the chasers from being rotated beyond a predetermined point and opened further than required, and by setting it so that the chasers open to just the outside diameter of the work, the fine burr thrown up at the end of the thread is wiped off.

To change the chasers, the stop plate is removed by unscrewing its clamping pin, the head *a* then being drawn out until the chasers are clear of the cam, when they will slide out of place freely. When in position they are prevented from drawing out toward the front by tongues or keys, one of these being inserted at the side of each of the three radial slots in *a*, and a groove to correspond being milled in the side of each chaser. To remove the shank, when it is desired to use one of a different diameter, the nut *c* is unscrewed and the head of the die removed; the shank will then slide out through the cam and stop ring, the former being provided with a key-way through which the key in the shank is free to pass.

The die is closed, when operated on an automatic screw machine, by means of a finger, which is attached to the back of the turret slide and which, as the turret rotates, presses against a pin in the die head, causes the latter to turn until its driving pins and their bushings are in register and then forces it back into working position.

Each size of die is, of course, adapted for a number of different sizes of chasers, the one shown in this case having a diameter of 2 3-16 inches and threading work from ⅛ to ½ inch in diameter.

This die is manufactured by the Ideal Opening Die Company, 25 West street, New York.

The Conservatism of Tool Buyers.

It is getting to be pretty well understood that opposing guiding surfaces for parts of machines that move in straight lines should be close together in order to avoid what Professor Sweet has called the "bureau drawer effect," and we now see a good many tools designed with this point in view. It is, however, not always practically possible for a machine builder to follow his own inclination in such matters, and we ran across an instance of this the other day in talking with Mr. Le Blond, of Cincinnati. He said he had become convinced that the true way to guide a lathe carriage upon the bed was by a large "V" in the front with a flat surface at the back upon which the carriage should merely rest. The advantage of this construction has been shown and explained by Professor Sweet, and it is believed in by most of those who have studied the question.

Mr. Le Blond said that he fully agreed with this, and, believing it, he for a time made his lathes in accordance with it. He found, however, that there was so much prejudice against it on the part of people who did not appreciate its value, they found so much fault with it, and it was on the whole so much trouble to educate his customers up to the point of appreciating that construction, that he finally decided to follow the line of least resistance and abandoned it, so that his lathes are now made with a "V" for the carriage both back and front in the usual way. In other words, they are made inferior to the best possible way simply because customers, or a majority of them, will not have the best construction.

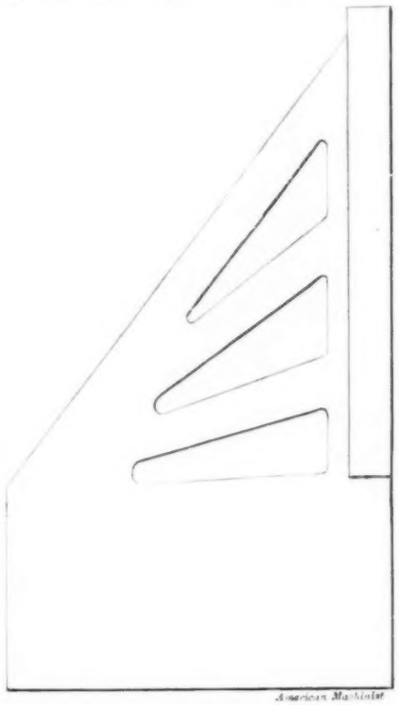


FIG. 1. CORRECT PLANER UPRIGHT.

Another instance of this difficulty is to be found in the planer upright designed by the G. A. Gray Company, and which was used on a frog planer built by them and shown at page 167, Vol. 20. We believe that this upright is strictly correct, and that it is the only one for which that claim can be made. Probably the G. A. Gray Company believe that as well, but it is doubtful if it would pay them to use it on their regular planers, simply because so many of their customers would not understand it and would be inclined to prefer the form with which they are more familiar, but which can be, and has been, shown to be wrong, from a consideration of maximum strength and rigidity with a given weight. Probably few builders would dare to put uprights like Fig. 2 on a planer, but such a form can, we believe, be shown to be better than the one commonly used; *i. e.*, with a given amount of metal greater strength and rigidity could be secured by such a form as Fig. 2 than by the conventional form, and there would be greater accessibility both for light and for the workman.

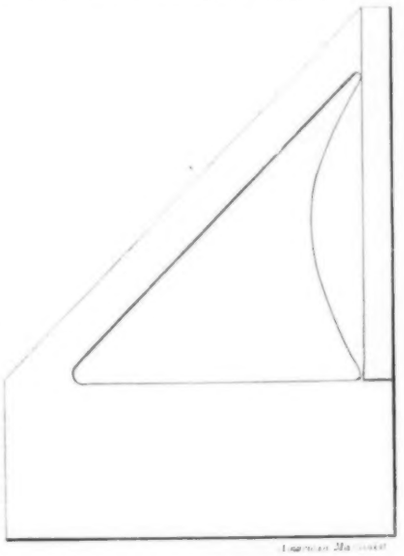


FIG. 2. A PLANER UPRIGHT.

The Summer School of the University of Wisconsin.

We have received the announcement of the summer school of the above-named institution, which is intended largely, though by no means entirely, to supplement the work of correspondence schools. The work offered is quite comprehensive and includes steam, gas and gasoline engines, dynamos, motors, electric wiring, transformers, telephone service, machine design, drawing, shop work, etc., the instruction being given by both lectures and laboratory work. There are no stated requirements for entrance, though a fair knowledge of the English language and of elementary arithmetic are necessary. The length of the course is six weeks, and the entire necessary expenses, including board, are estimated to be fifty dollars, which amount does not include transportation.

At the first session forty-four students were enrolled, and at the second nearly seventy. Full particulars, with the courses of instruction in detail, may be obtained by addressing F. E. Turneaure, University of Wisconsin, Madison, Wis.

Cutting Racks—Approximate Sizing of Gear Blanks.

The problem of cutting good, accurate racks at a fair cost is not as simple as it looks, and a good many elaborate special machines have been constructed for doing it. The rack used for driving a planer platen is important, and no planer can possibly work as smoothly and satisfactorily as a first-class modern planer is expected to, unless its rack teeth are accurately formed and as accurately spaced. All planer builders who build good tools have given the problem considerable attention, and the solution arrived at by the Cincinnati Planer Company is illustrated by the accompanying engravings.

This company, following the modern idea of specialization, builds nothing but planers, and for the work of doing that endeavors to have the best possible appliances and to adopt the best possible methods. Their rack cutting is done upon one of their own planers, which when at work on this job looks like Fig. 1, where sections of racks made of a length equal to the width of the planer platen are shown bolted to the platen, so as to practically cover it. These sections are afterward fastened to the under side of the platen, where they are to work by means of screws passing through the flanges on either side of the toothed portion of the rack (as indicated by the piece on the floor at the right), and they are fastened to this platen for cutting by the same method, the bolts going down into the T-slots, where they enter tapped holes in blocks shown by Fig. 4.

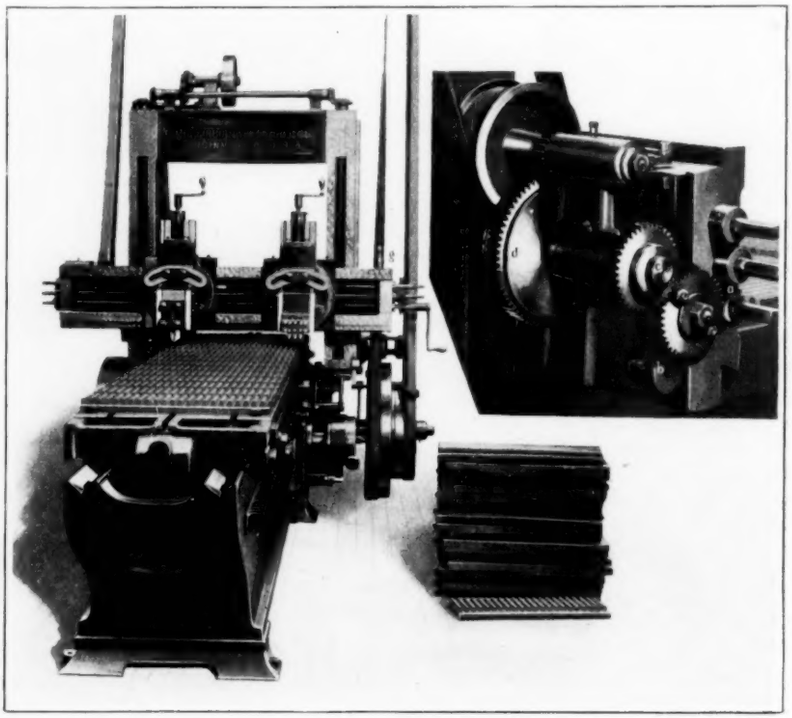
First the teeth are roughed out by the tool shown in Fig. 1, in which three cutters (of self-hardening steel) are used, these being fitted to and placed within a block that takes the place of the regular clapper, and has grooves properly spaced for the pitch of rack to be cut. After this they are finished by a single tool shown in Fig. 2, this being ground to fit a holder (the shanks all the same size, regardless of pitch), and these cutters are formed by Brown & Sharpe, each one especially for the rack it is to cut and the gear that rack is to r n with—the one shown, for instance, being for a 3-P rack, to be driven by a 57-tooth gear.

Accuracy of spacing is of course very important in rack cutting, and for this a special device is used which is driven by the belt shown at the left of Fig. 1. At the right of this figure is a view of the indexing mechanism at the end of the cross-rail, and Fig. 3 shows some details of the same. A pinion *a* on the cross-rail screw is driven by a compound intermediate which is placed upon a swing-plate *b*, this being driven in the manner clearly indicated, through the medium of a friction gear *d*. At each indexing movement this friction gear makes one turn, and suitable gears are introduced into the train to give the proper tool movement for the pitch required. So when the operator wishes to move from one tooth to another he simply moves a small lever seen standing up near the right-hand end of the cross-rail in Fig. 1, then lets go of it, and the machine does the rest. The effect of the movement of the lever is to withdraw the plunger *f*, Fig. 3, and this allows the friction plate and the gear attached to it to make one turn with the large gear.

Should the operator wish to return the tool to any previous position, he may do so by simply turning the crank-handle on the cross-rail screw in the ordinary manner, the beveled surfaces on *f* and *g* forcing the former back as they pass; when he releases the crank-handle the friction drive will bring the stops into contact again, as shown in Fig. 3, and this will be the correct position for some tooth. The amount of friction in the wheel may be regulated by means of the screw *c*, at the right of Fig. 1, and the two bolts seen in the intermediate are for getting a more accurate positioning of the finishing tool for the first tooth than would be possible by turning the pinion *a* one tooth. These bolts hold the two gears together, and they enter slots in one gear, so that when loosened a fine adjustment of the finishing tool can be made. The connection between plunger *f* and the lever by which it is moved is shown also in Fig. 3, the broken rod being long enough to reach the length of the cross-rail.

Having secured accuracy of form and of spacing the equally important point of securing the proper and a uniform depth of cut is secured by cutting the first tooth to a hardened and ground plug, then setting the graduated collar on the down-feed screw to zero and bringing it to the same point at each subsequent cut.

It is a simple device—composed of well-known mechanical elements; the accuracy of the form of the tooth depending upon the finishing tool and ultimately of course upon Brown & Sharpe's special appliances for securing accuracy in such things, while the accuracy of the spacing depends upon the cross-rail screw and the straightness of the cross-rail itself. These are looked after carefully and the resulting racks stand every practical test.



PLANING RACK TEETH.

I noticed here also a device for cutting spur gears which interested me as an example of avoiding some of the time-honored but roundabout methods of securing accuracy at the point desired by the doing of careful work at intermediate points where it is not desired and can do no good. In other words, they "cut across lots" and get directly at the point they wish to attain. We all know that exact and precise sizing of spur gear blanks is not necessary for itself. If a bull-wheel blank varies 1-64 inch in diameter it will do no harm in and of itself, but the trouble is that the man who cuts this gear will, if he pursues the ordinary method, bring his cutter down till it just touches the blank, and then set it as n any thousandths deeper as a certain table calls for for a cutter

of that pitch, and thus the distance of the pitch line of the cutter from the center of the gear is made to depend upon the size to which the blank has been turned, and if one is wrong the other is also. In this shop that difficulty is overcome simply by disk gages made of cast iron and the diameter of which is equal to the exact diameter of the wheel to be cut *at the bottom of the teeth*; in other words, a gage's diameter is equal to the pitch diameter of the wheel to be cut, less the diametral pitch and twice the clearance. This gage is put into the arbor with the blank to be cut and the cutter set to just touch the gage. Then when the cutting is done it is done at the right diameter; *i. e.*, the pitch line of the cutter will coincide with the real pitch line of the gear, regardless of whatever variation there may be in the size of the blank; such variation affecting nothing except the amount of clearance of the gear teeth in the rack. Of course the sizing is done with sufficient accuracy to avoid making a noticeable variation in the amount of clearance, but there is no necessity for doing it to the degree of accuracy demanded in setting the cutter to the proper distance from the center of the gear, and the greater directness in securing the result sought has of course a tendency to make strictly accurate results more sure, aside from the fact that it saves the cost of accurately gaging the blank when it is being turned, avoids the doing of very careful work in a place where it can contribute nothing to the satisfactory working of the tool, and thus leaves a greater margin within which to bestow careful work where its effect is really beneficial.

F. J. M.

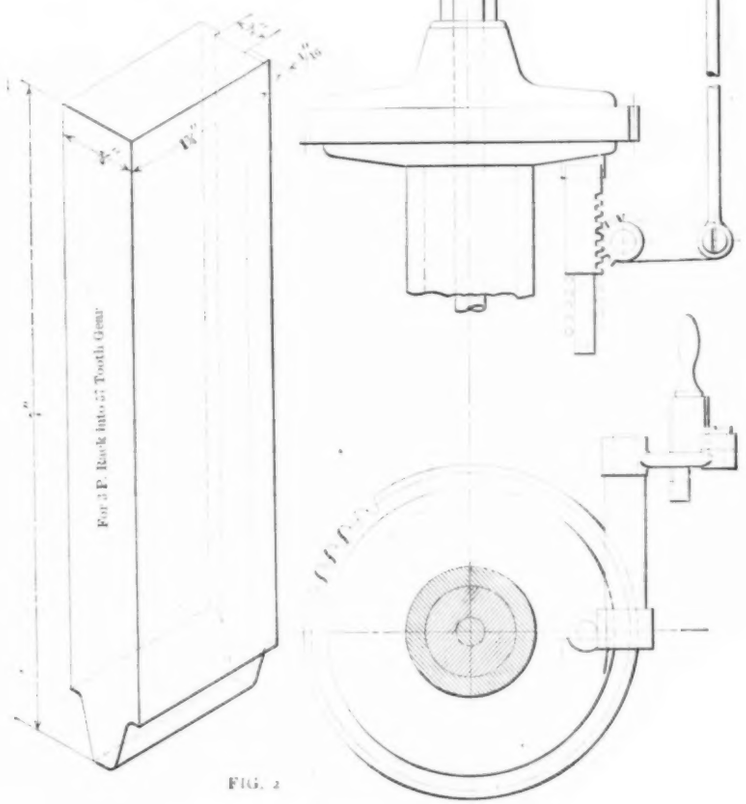


FIG. 2

FINISHING TOOL FOR RACKS.

Molding Sand.*

Eternal vigilance is the price of good molding sand as well as good castings. Without it we get into a rut and stay there until we lose our energy and ambition, and take it for granted that everything is going smoothly, until the unpleasant but inevitable awakening. Some men have spent most of their lives in a foundry, yet to-day make no better castings than years ago.

Sand is part of the foundation, in some of its various forms, of the greatest structures of the world (and its greatest men), as well as of the foundry business; and yet in all its various uses it receives but little consideration as compared with other materials used in conjunction with it. There are different kinds of sand, as there are different kinds of people, and their uses are just as divergent.

The sand in which you are most interested was first discovered in the Albany and Jersey territory, and has ever since enjoyed the confidence of the trade, and when selected by experienced and reliable men still justifies this confidence. Albany sand is a surface or shallow-veined sand lying immediately below the top or agricultural soil, which runs from 7 to 10 inches and is stripped off in benches about 3 feet wide, running the length of the pit, or as long as may be convenient. The underlying sand will run from 6 to 24 inches deep, with an occasional pocket running 3 to 5 feet, but the average will not exceed 18 or 20 inches. When you know that from 25,000 to 30,000 cars, or 900,000 tons, are shipped from this territory annually, you will see that a vast territory has been worked over and that all sand sold in the last fifty years could not have been Albany sand, nor could all Jersey sand have come from the original pits.

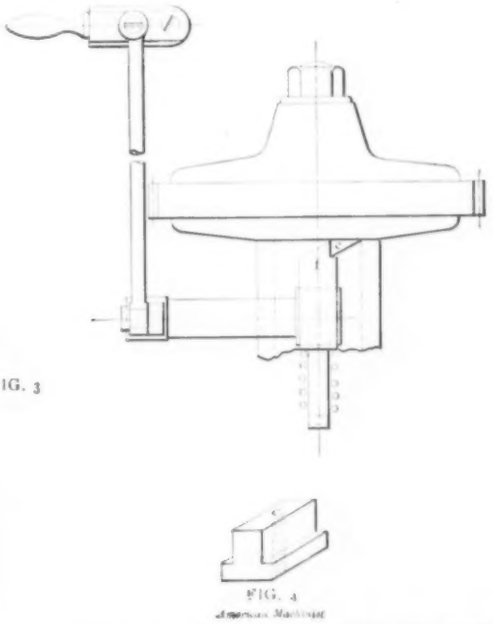


FIG. 3

FIG. 4

DETAILS OF INDEXING MECHANISM FOR RACKS.

The next territory in age and reputation, supplying the market west of the Alleghany mountains, is that in which I am interested—Conneaut and Kingsville—which has been supplying the trade for forty-five years, and about twenty years ago became the first formidable competitor of Eastern sand. It is a close duplicate of Albany sand. This sand is also shallow-veined, and the pits in our territory are operated the same as at Albany. These sands have always been known as "safe" sands, containing the necessary bond, and yet open enough to vent freely and not scab, cut or blow, with reasonable care.

The next sand territory of like nature has been known as Sandusky, but on account of its running to the extreme in openness, and nearly every farmer loading his own sand, and not knowing a snap flask from a cupola, and with supervision which is but little better posted, its use has been confined to its own locality, its quality never retaining a trade that would carry freight rates of $1 to $6 a ton.

* F. E. Gordon, before the Pittsburg Foundrymen's Association.

Ohio has still another territory well and favorably known in other markets as well as Pittsburgh. I refer to the Zanesville sands, generally known as Zanesville Red and Zanesville Fine. These sands are all deep vein sands. Stripping runs from 2 to 12 feet. They are of a different nature entirely, and yet have their uses and friends.

Pittsburgh has a great reputation for heavy castings, but some foundrymen in Pittsburgh have demonstrated beyond a doubt that as poor castings can be made here as anywhere else. Foundry practice has also demonstrated that castings can be made in almost any kind of material, but from a personal experience of seventeen years in the foundry business and ten years in the sand business, I have come to know there is a happy medium in this as in all other things. In deciding the sand question, however, it is hard to arrive at this happy medium.

The difference of a few cents or dollars a ton on an invoice is easily computed, and too often decides the quality when it is the purchasing agent or office man who decides it. If the man who has to produce satisfactory castings at a satisfactory price complains, he is frequently told that so and so use it and they do good work; but how about the cost in ambush? The foreman may say this sand requires more care on the part of the molder to produce good results, the percentage of loss is higher, and the cost of cleaning or waste of the sand is greater; but all this is largely a question of estimate, while the office is positive of the invoice difference of 5 cents a ton, and that counts, and the dollars in ambush are not discovered soon enough, if at all.

Sand, one of the largest factors of production, is one of the very smallest items of cost per ton of castings, and 5 cents per ton will decide the sand quality quicker than $1 per ton will the iron. I take the position that the "man behind the gun" is the man who should decide upon the cost and quality of the molding sand. He is responsible for "hitting the target," and if he has not the power to decide upon the materials that are necessary to accomplish this result, human nature will not permit him to exercise the same energy, the same eternal vigilance that he otherwise would. You may supply your foundry with the best coke, the best iron, the best molding machine, the best patterns, the best flasks, the best mechanics and the best of everything else, and you will fail to get results unless your foundry management has the molding sand that meets its approval. The proper sand for the purpose can be obtained at a reasonable first cost, and as the difference between the first cost of the cheapest material you can secure, and the choice of the best material on the market, will seldom exceed $1 or $1.50 per ton, I insist that you cannot take the cheap material, if it is not originally adapted for your purpose, and obtain the same results at the same cost that you can with the higher priced article.

The time spent by the laborer, facing mixer and molder in toning up an inferior article corresponds to part of the cost in ambush previously referred to. A secondary part of this cost in ambush is the discount pile in the foundry. The next is the increased expense in cleaning and correcting the imperfections in the casting as it leaves the molder, and last, but not least, when the casting has been entirely completed in the foundry, passed over the scales and on to the books, to its last and final test, it enters the machine shop, and hours and sometimes days are spent in machining it, and then a material defect is discovered, and the loss in this direction in its grand total is appalling.

It is said that more than 20,000 laborers are employed in the automobile factories of France. About 5,000 new vehicles, valued at $6,000,000, were made last year. At the Paris Exposition in the same year no fewer than 700 manufacturers were represented.

Speed Changing Gear for Radial Drill.

We illustrate herewith a novel speed changing device which the Wm. E. Gang Company, of Cincinnati, Ohio, are applying to their radial drill. Fig. 1 shows the complete machine, and Fig. 2 the gear box with a portion of the cover removed, while Fig. 3 gives sectional and end views of the device. This gear arrangement is driven, as indicated in the illustrations, through a single pulley, and gives the spindle driving shaft nine changes of speed, the spindle itself, through back gears with which it is provided, having eighteen

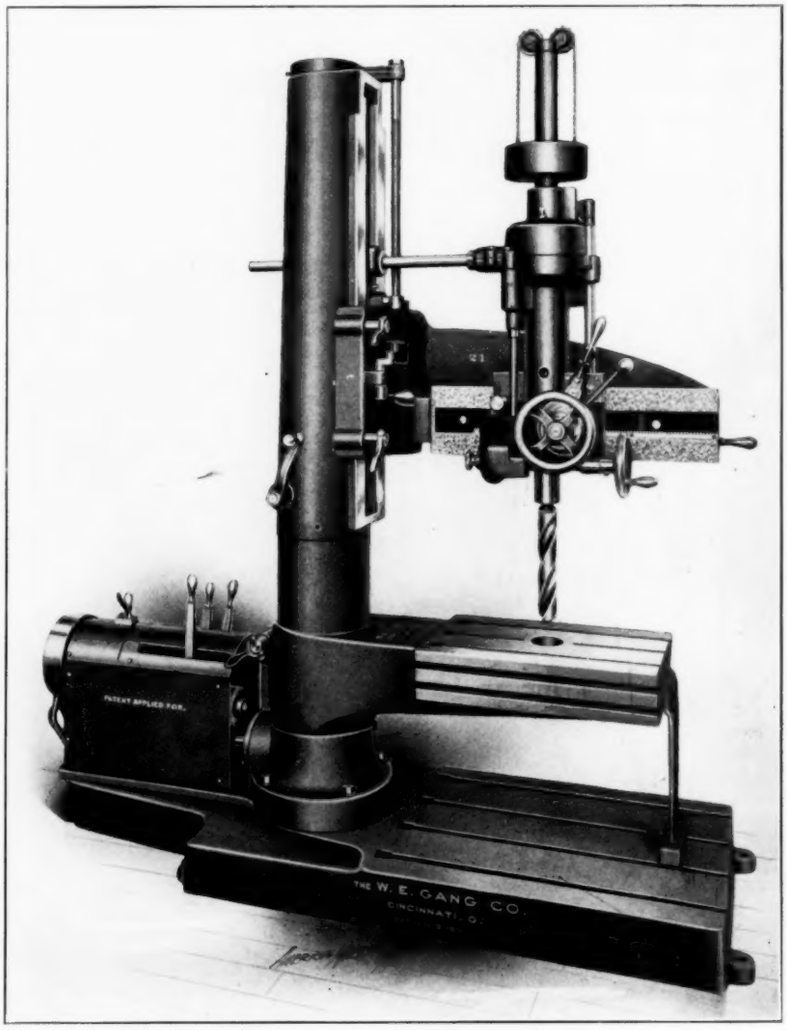


FIG. 1. RADIAL DRILLER WITH SPEED CHANGING GEAR.

speeds, these ranging from 25 to 400 turns per minute. All changes in the speed-varying device are conveniently made by means of the upright levers projecting from the casing. Both the arrangement of the gearing and the mechanism for controlling it will be clearly understood from Figs. 2 and 3. Referring to these engravings, it will be seen that the gear box contains three sets of gears of three gears each. The gears *A*, *B*, *C* and *D*, *E*, *F*, Fig. 3, are mounted loosely on their shafts *G* and G^1; the shafts are journaled in the frame at each side of the gear and are

free to slide through gears and bearings. The intermediate gears *H*, *I* and *J*, which are fast on a shaft, mesh respectively with *A D*, *B E* and *C F*, three trains thus being formed.

(shown at the upper part of Fig. 3) and loose collars *M* and *M*'. The driving pulley *N* has a long hub which is journaled in the frame *O*, and bracket *P* is provided with a key fitting a spline in shaft *G*. The

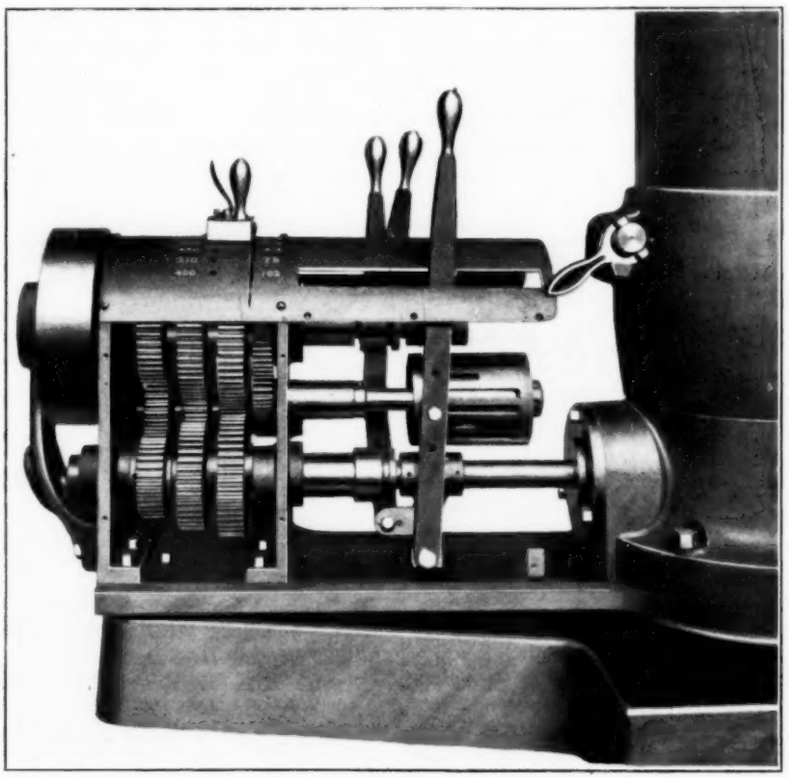


FIG. 2. GEARING AND CONTROLLING MECHANISM.

the grooves in drum *S*. This drum has, as shown in Fig. 2, a groove turned around the outside and near the end connecting with six long and six short longitudinal grooves. The splined shaft *T* journaled in *U* carries a gear segment *V* fast on one end and drum *S* on the other. Gear segment *V* meshes with another segment *V*', which is mounted loosely on a boss formed on wall *W*. The arrangement is such that the projections on the dogs *Q* and *Q*' enter slots on opposite sides of drum *S*. The action in indexing to obtain a given speed is as follows:

Lever *X* is drawn to position 1, as indicated by the dotted lines, thereby sliding the drum *S* on shaft *T*, and by means of the dogs *Q* and *Q*' engaging with the drum, drawing shafts *G* and *G*' with it. The friction clutches are now in gears *C* and *F*; and the projections on dogs *Q* and *Q*' being in the circumferential groove in drum *S* permit the drum to be rotated by means of shaft *T* and segments *V* and *V*', these segments being operated by handle *Y*. When this handle is set opposite the figures showing the required speed (see Fig. 2), the lever *X* is drawn to the position 2 indicated by the full lines. This movement locates the friction clutches in the proper gears to give the required speed, and the clutches are then set by means of levers *R* and *R*'. The clutches are adjusted by means of a wedge and screw, as shown.

The drive from the speed-varying gear to the spindle is through shaft *G*', a vertical shaft in the column, and horizontal

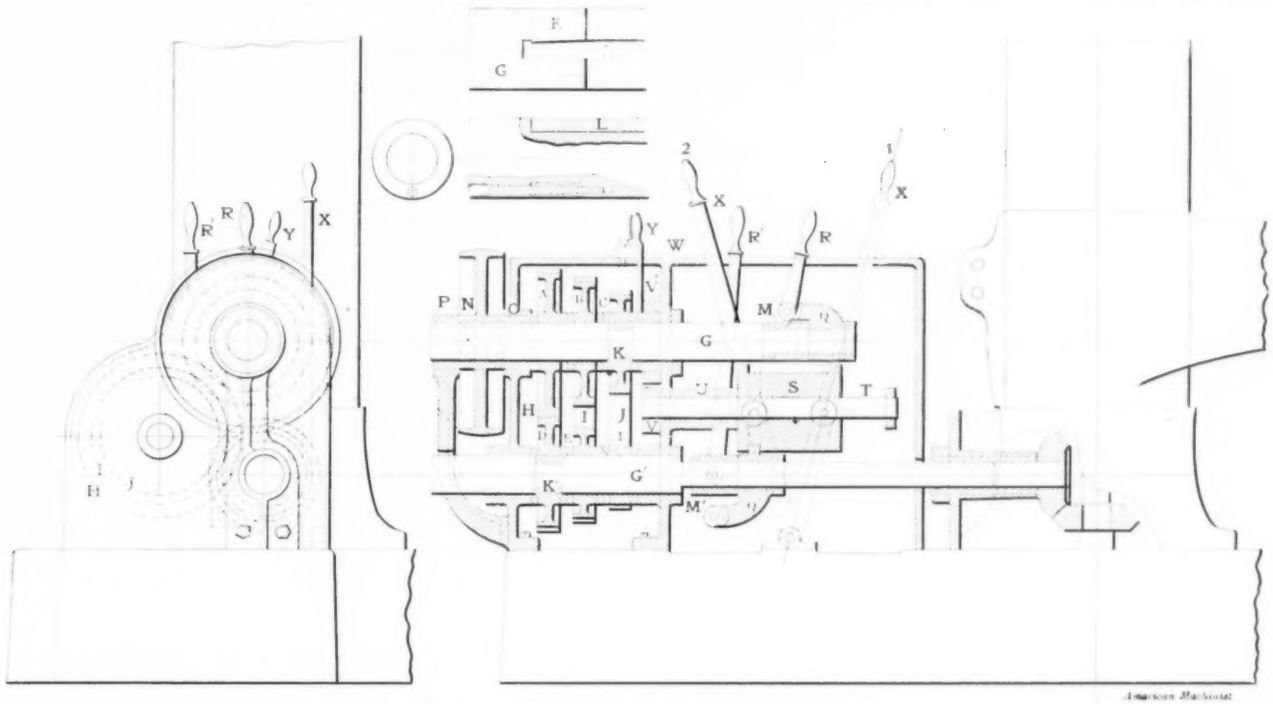


FIG. 3. GEARING AND CONTROLLING MECHANISM.

The shafts *G* and *G*' carry friction rings *K* and *K*', which engage in the bores of gears *A*, *B*, *C* and *D*, *E*, *F*, and are operated by means of the sliding wedges *L*. dogs *Q* and *Q*' are fitted with pins acting as fulcrums for the levers *R* and *R*', are loosely mounted between collars on shafts *G* and *G*' and have projections which fit

shaft projecting, as shown, from the inner face of the column, these shafts and the spindle being connected by means of suitable gearing.

Milling Keys.

BY A. MILLER.

In designing special tools for doing an operation or a series of operations on a machine part, it is an easy matter for one with experience to find some way to go about it; and, if given much thought, a number of ways may be worked out, thus oftentimes making it a hard matter to decide which is the best, as in doing so there are several points to be considered, such as the number of pieces likely to be made, the degree of accuracy required, etc.

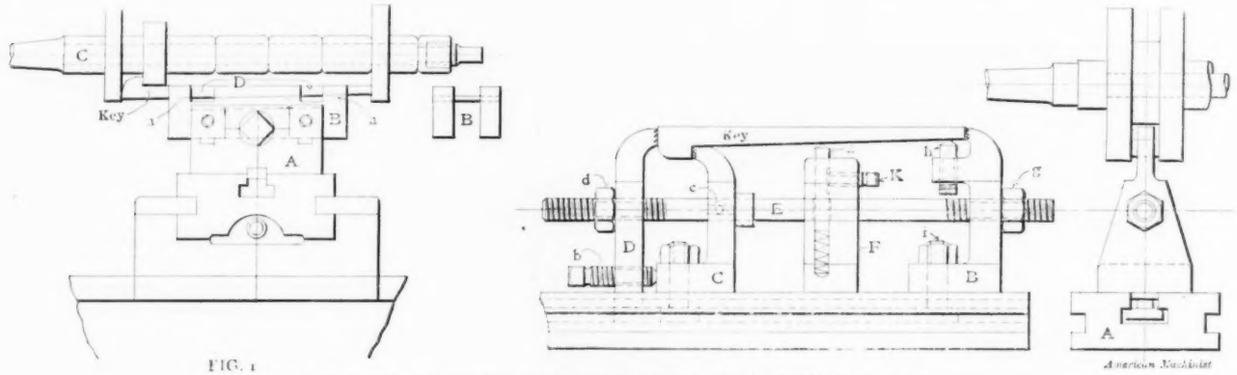


FIG. 1

TOOLS FOR FIRST AND SECOND OPERATIONS ON MEDIUM SIZE KEYS.

Very likely many of us in this branch of the business have come across some of those that think the time of a draftsman should be charged to the side of "Profit and Loss" and that he should be able to devise, at the first attempt, the best method of doing a job; but my experience has been that those who are the most progressive wish to see a number of ways worked out before deciding which is the best. It has fallen to my lot to be one of the "necessary evils," and for some time I have been connected with a concern whose product consists of a large number of different pieces, with several sizes of a kind; of some of these only a few are used in a year, while others are used in large quantities. In order to make the parts interchangeable and also reduce the cost of manufacture, it has become necessary to make a number of special tools; and, as it is also necessary to keep down the expenses of the tool-making department, in a number of cases the jigs and fixtures are constructed in such a way that by making some few changes the tool will answer for several sizes.

One very interesting set of tools of this kind that worked satisfactorily was for milling keys, these being made in large numbers. They range from 3-16 inch wide by 1¾ inches long, to 3½ inches wide by 2½ inches long, the taper in all cases being ⅛ inch per foot. Up to the time of making these tools I had been in the habit of making separate fixtures for each piece, but, there being so many sizes of keys, we soon came to the conclusion that in this case it would be useless to do this; and so, after laying out several types of fixtures, one was selected in which five different sizes, including those from ⅝ inch to 1⅛ inches wide, could be handled. The blanks were drop forged, and the first operation was to mill them all to a length and under the head. We used for this a common milling machine vise *A*, Fig. 1, with a pair of jaws *B* fitted to it, and in order to mill the short lengths two slots *D D* were made for the mills to pass through. The keys were supported by pins *a a*, which were tight in one jaw and loose in the other, and three mills taken from stock were used on the arbor *C*, as shown.

The second operation was the milling of one side and two edges; the fixture for this is shown in Fig. 2. *A* is the milling machine table; the supports *B* and *C* and the clamp *D*, which are made of tool steel, are provided with fine teeth for gripping the key, and hardened. *D* is shaped at the bottom to fit the slot in the table and is thus prevented from lifting up when clamping the work. Only one clamp bolt is required, as this extends all the way through, as shown at *E*. The pin *c* keeps it from turning when the nuts *d* and *g* are tightened. It was necessary to support the key in the center, and this was done with the block *F* fitted with a spring pin *a*, which, when forced up to the work, was clamped with the set-screw *K*. In securing the work the clamp *D* is first made fast, the set-screw *b* being set to accommodate the head of the key; this forces the other end down on screw *h*, which is set so as to leave an equal amount of stock on the under side for finishing to size. *B* was left free to move on the table until nut *g* was tightened, after which it was made fast; the pin *a* was then secured and the work was ready for the milling operation. The cut was started on the end with the head, and although the tendency was for the mills to pull the work out they never did.

Two clamps like *D* were required, one being wider than the other at the top. The five mills used for the flat sides were the only ones that had to be made, as the side mills were taken from stock.

The third operation was to mill the other side, and for this the vise was fitted with another pair of jaws, *A B*, Fig. 3. The keys rested on the studs *C D*, one end of each of these being tight in *A* but loose in *B*. *C* was enough higher than *D* to allow for the taper of ⅛ inch per foot. Each of these studs was made with the four sides of the central portion at different distances from the center, and by turning the studs around the different keys could be milled to the right thickness. In each stud was a dowel, as shown, this being used for locating it, as the position was changed, so as to bring the tops of the two in a straight line, as indicated by dotted line *a*. Two sets of holes were made in the jaws for the studs to suit the different sizes of keys. In the center of *A* is driven a stud *E*, which is provided with a screw for supporting the work in the middle. A mill 12 inches long, made in three parts and cut a steep spiral, was made for this operation and answered for all sizes.

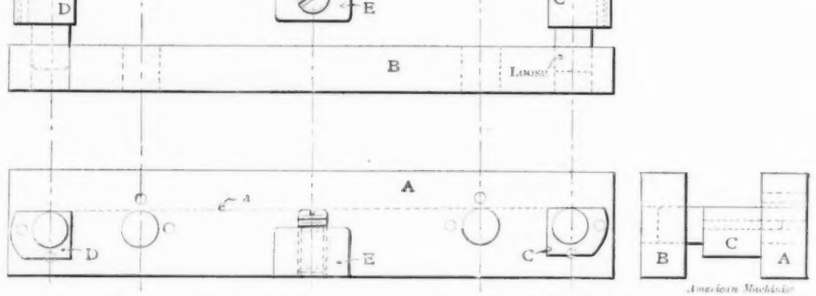


FIG. 3. VISE JAWS FOR THIRD OPERATION ON MEDIUM SIZE KEYS.

The tools for the first four sizes of keys

were very simple. The first and third operations—that is, the milling to length and thickness—were performed in one set of jaws shown in Fig. 4. *A* and *B* are the vise-jaws, and three pieces, *C*, *D* and *E*, are fitted to *A* for the keys to rest on, they being made to give the proper taper when milling the top of the key. *D* and *E* were made to interchange for the two small sizes, *C* answering for the other two.

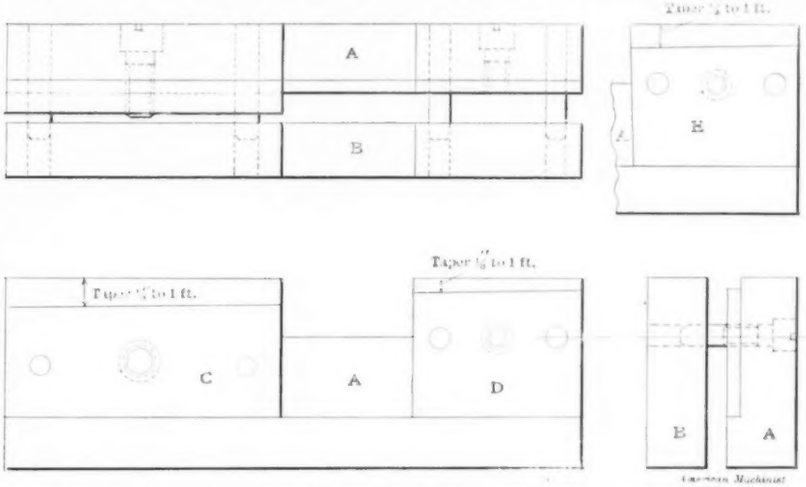


FIG. 4. VISE JAWS FOR FIRST AND THIRD OPERATIONS ON SMALL KEYS.

Fig. 5 shows the tools for the second operation. The jaws *A A* were fitted to the vise, and to these were fitted parts *C C*, made of tool steel and hardened. The latter were provided with fine teeth for gripping the stock, and held in place by set-screws *a a*, as shown; a pair of these was made for each size. The mills *B B* were standard and in stock, but four cutters, *D*, were required.

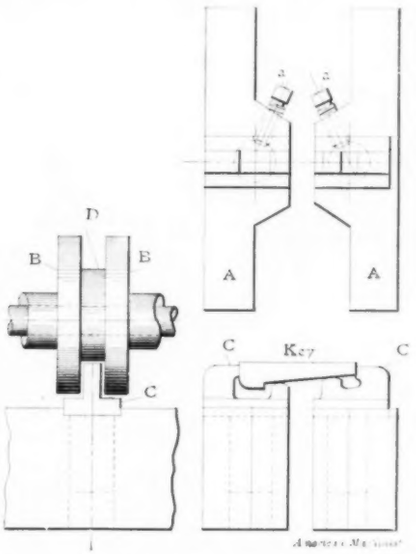


FIG. 5. VISE JAWS FOR SECOND OPERATION ON SMALL KEYS.

The larger sizes of keys, beginning with those 1¼ inches wide, were used without heads, as they were for cranks and fly-wheels, and were driven in flush with the end of the shaft; these had always been planed, and from stock long enough to make two and sometimes three. In fitting them it is necessary to drive them in and out several times, and in order to drive them out it had been the practice to bolt a block to the end, as shown in Fig. 6, but this was very unsatisfactory, as the bolts had to stand the force of the blow, and they soon gave out. To overcome this trouble, we milled two slots crosswise in the blank and made a block *A* of tool steel with tongues to fit, and bolted it on as shown in Fig. 7; with this the blow was taken by the tongues and each block lasted for a number of keys. One of the slots was made wider than the other, so that the block could not be put on the wrong way. A drill jig was made that would drill all sizes of blocks and key blanks, and was also used as a gage for milling both. Three sizes of blanks were made, and answered for all sizes of keys.

A table was laid out showing the large sizes for which tools were made and furnishing instructions to the workmen; this table giving the size of stock to use for any size of key, the dimensions of finished key, the length for cutting up the stock, the different operations in proper order, and the sizes of the milling cutters required.

A list of this kind is very helpful to the operator in setting up the machines, as he is able to select without delay just the mills he requires for the different sizes.

Only three sides of these large keys were milled, the other side being left to be planed and fitted as required; this is done one key at a time, after which it is cut off and another one planed up and fitted as before, so if this side was milled only the first key would be right.

Fig. 8 shows the milling fixture for these keys. The principle is similar to Fig. 2, with a few changes in the construction. *A A* are made of cast iron, *B* and *C*, the clamps, are tool steel—with gripping teeth—and hardened; *D* is a support and *E* a support and clamp; *C* and *D* are both of the same width at the top, and only one of each was made. *B* and *E* also were made the same width at the top, but it was necessary to make two of each, as the cut started on this end, and it was thought best to give the largest sizes more holding surface. For most sizes two blocks *F* with spring pins were used for supporting the work between the ends.

This fixture is operated in the same way as the smaller one shown in Fig. 2, but when clamping the work we usually strike the tops of clamps *B* and *C* with a lead hammer to drive the teeth into the stock. The side mills for this fixture were in stock, but most of the others had to be made.

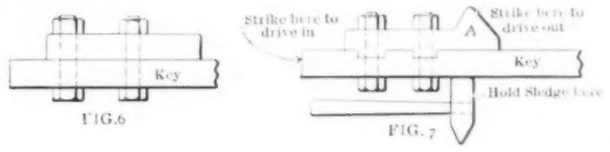


FIG. 6

FIG. 7

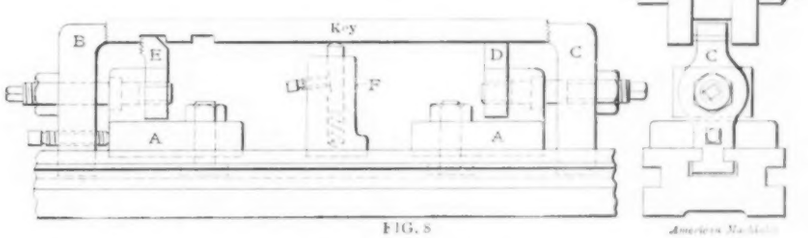


FIG. 8

TOOLS FOR LARGE KEYS.

The Growth of the Locomotive.

As a marker of recent progress it is worth while to note the dimensions that the locomotive has reached. The following data are given by the *American Engineer and Railroad Journal* of the new passenger locomotives for the Chicago & Alton: They have 4,078 square feet of heating surface and carry 220 pounds boiler pressure. They weigh 219,000 pounds and have 141,700 pounds on drivers, with 15,000 pounds added to one of them by a traction increaser. One of them can produce a draw-bar pull of over 34,000 pounds, and this is for passenger service. In the details of construction are found 10x12-inch main driving journals and 7x7-inch crank-pins for the main rod connections.

Bench Lathe Chucks and Attachments for Operating Them.

BY JOS. M. STABEL.

I show herewith several chucks—and the devices for operating them—which have proved invaluable in interchangeable bench lathe work, such as fine tool, instrument, watch and other small work, which may require some further operation after leaving the screw machine or press. Sometimes the piece may be nothing more than a ring, which is to be faced off to an exact length; then again it may be a drawn shell which must be faced or turned accurately; or, perhaps, some threaded pieces have to be held true by the thread while some accurate turning is done on them; the several kinds of chucks shown answer for these purposes very satisfactorily. Fig. 1 gives side and end views of a bench lathe with an expansion chuck and its operating mechanism. As a great deal of time is lost in stopping the lathe to release and replace the work a mechanism was constructed that would expand or release the chuck with the spindle running. All that is now required of the operator in chucking and removing work is to press downward with the foot on a treadle connected by a cord with the chuck operating device, the treadle when pressed expanding the chuck in the work, and when pressed again allowing the chuck to contract and release the piece.

The cord passes through a hole in the bench and is fastened to a lever *A*, which is always held in an upright position by a spring *B*, and which carries a pawl *C* that engages the four tooth rachet wheel *D* formed on cam sleeve *E*. The groove in the cam is zigzag and ¼ inch wide by ⅛ inch deep. The sleeve is of mild steel, case hardened, and is a running fit on stud F, which is screwed into a flat piece of steel and held rigid against the head of the lathe with four ¼-inch screws. The body of lever *A* is a free fit on the inner end of sleeve *E* and back of the ratchet wheel. As the lever is actuated by pressing on the treadle the pawl turns the sleeve one-quarter way round, the sleeve in turn through its cam groove imparting a longitudinal movement to the fork *G*, a screw *H*, in this fork traveling, as shown, in the groove. The fork, as it moves, slides the cone *I*, which is mounted on part *J*, either under or away from clutch fingers *K*. These fingers, when the cone slides under them force rod *L* forward, and the hardened expander *M* screwed in the front end of the rod expands the chuck *N*. The chuck is made separate from chuck body *O*, so that different sizes may be made at small expense. The spring *P* bears against the expanding rod and the chuck, thus helping to release the expander from the chuck when cone *I* is moved—by pressure on the treadle—away from fingers *K*. The threaded ring *Q*, which holds the fingers, is screwed on *J*, this part being fitted on the end of the spindle and held there by four ¼-inch screws. Ring *Q* is split, as shown, and held in position by a clamping screw. The mechanism is inclosed by cover *R*. The rear end of the lathe spindle is shown at *S*; such spindles usually project at this end about 1 inch. *T* is a tube threaded internally at one end to receive chuck body *O*, and provided at the other end with a shoulder (drilled to suit a spanner wrench), which bears against the end of the spindle, thereby holding the clutch in position.

Fig. 2 shows a far simpler type of expansion chuck, but with this it is necessary to stop the lathe when changing work. This chuck can be used only in work where position endwise in the lathe is of no account, as one piece with a larger hole than another will naturally be located differently on the chuck, a little larger hole requiring a greater expansion, and consequently more end movement, on the part of the chuck. But for many classes of work it will answer the purpose very nicely. The body, which is shown at *A*, is hardened and ground all over. It is advisable to grind the part which goes in the lathe by holding it by the thread at the front end, this being screwed into a ring that has been chased in position. This method will bring the body proper true with the thread. The chuck should then be put in the lathe in its working position and the taper portion at the front ground. The expansion ring *B* is spring tempered, and its

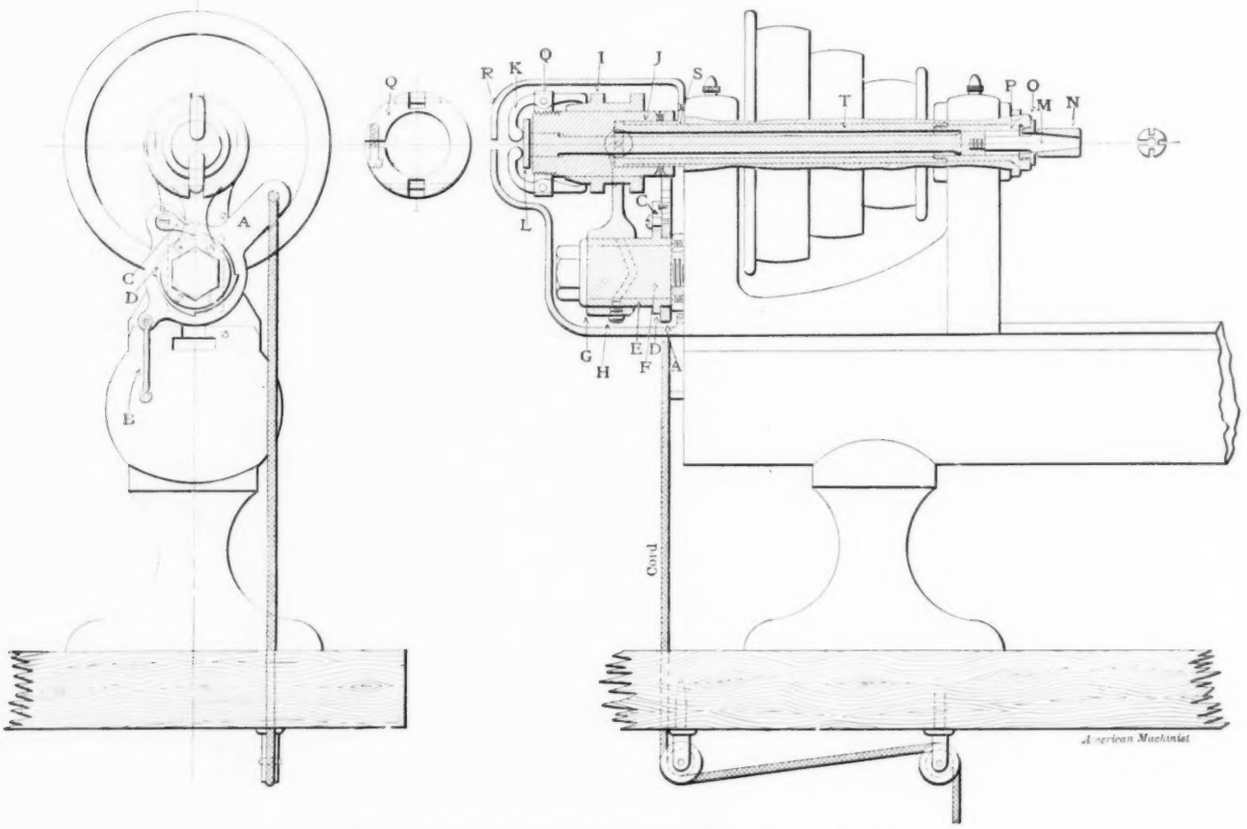


FIG. 1. CHUCK OPERATING MECHANISM FOR BENCH LATHE.

shoulder is a running fit in the recess formed between collar *C* and ring *D*, which parts are of mild steel, case hardened and knurled, and screwed firmly together.

Fig. 3 shows a device for holding threaded work; this is suitable also for holding threaded pieces requiring milling operations. Part *A* fits in the spindle of the bench lathe like the ordinary split chuck. It is made of tool steel and hardened, the hole being lapped out straight and the outside then being ground on an arbor. It is held in position, as indicated, by tube *C*. Arbor *B* is of tool steel hardened and lapped to a sliding fit in *A*, the thread being lapped to fit the work. Several threads at the end are ground off to the root to form a pilot, so that work can be screwed on with haste. The rear end of *B* is tapped out to receive the rod *D*, which has an elongated slot near its other end to enable the cam *E* to travel through. *F* is a washer bored for rod *D* and provided with a boss which fits tightly in *C*, thus holding the rod central; on the other side of the washer a slot is milled to receive the flat piece of steel *G*, which passes through the slot in *D* and forms a bearing surface for cam *E*. Plate *G* is secured to washer *F* by two screws.

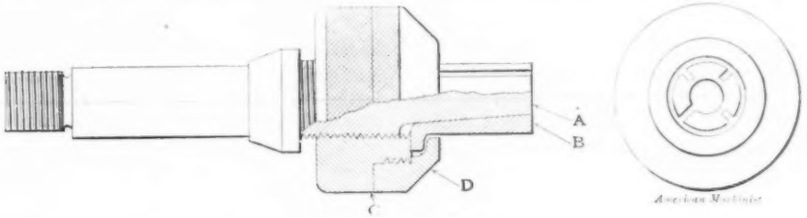


FIG. 2. SIMPLE EXPANSION CHUCK.

The action of this device can be readily seen: after screwing the work on *B* the cam lever is pressed down, drawing rod *D* and arbor *B* back, and bringing the work against *A*, where it is held securely; when cam *E* is released the work can be removed readily and without pounding it to loosen it on the arbor.

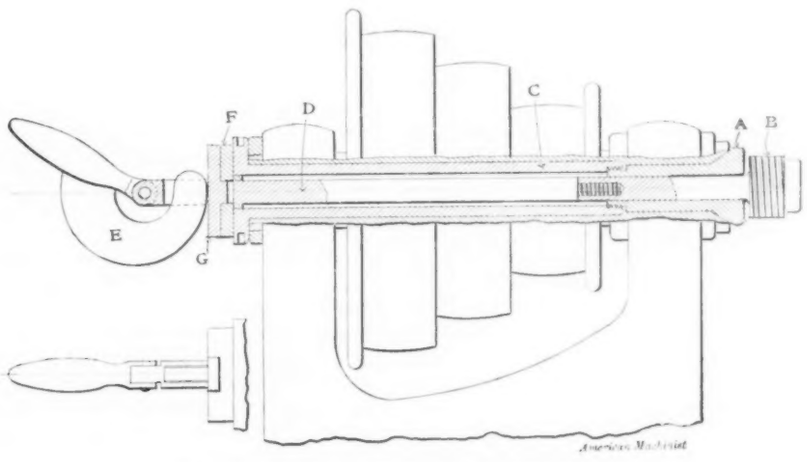


FIG. 3. MECHANISM FOR HOLDING THREADED WORK.

Notes From Lancashire.

BY JAMES VOSE.

In the article "Notes en Route" in Vol. 25, some details of the performance of an "eccentric" sawing machine were promised. I must confess to a personal interest in the tool, having in consequence of special developments in the work I was engaged on, induced E. G. Herbert to consider the matter and eventually put such a tool on the market. The machine is particularly useful for cutting constructional steel work of usual sections, and also in my own case, cutting from the billet, disks of various thicknesses, which are afterwards tooled to make steam flanges and tees. This method of producing these articles appears to work out well, as no outside manufacturer's tender price is able to compete with it.

The vise is capable of swivelling on its base, enabling girders, etc., to be mitred, or the vise may be removed and work bolted to the slotted base. A rotary pump may also, in certain cases, be used to keep the saw blade cool while running much over normal speed. Just where the benefit of the cooling liquid begins and ends is an interesting point on which opinions may easily differ. As previously explained the peculiar feature of the machine is the periodic changing of the inclination of the saw blade, imitating the action of manual sawing. This is effected by mounting the guides of the saw frame on an eccentric on the main shaft, the eccentric being so geared as to make a portion of a revolution every 20 strokes. Comparatively thin blades, 17 inches long, are used and give the best general satisfaction.

Regarding the cost of cutting various sections the figures given herewith are about correct, being the mean of a number of everyday jobs. A 20-inch girder would cost 5 to 6 cents; 8-inch square slab, 30 cents, and other sections in proportion. In the case of such work, the total cost is probably a more just criterion than a statement of the time occupied. The costs given include first cost, depreciation, saw blades, and labor.

A noticeable feature in American radial drilling machine practice is the small sized tables furnished with them. The same remark applies to many of German manufacture. The American user would appear to be prepared to himself provide special jigs and fixings for holding down work, which a table of area proportionate to the radial capacity of the drill would render needless, ordinary cramps, etc., sufficing. Radial drills might also, with advantage, be more often equipped with adjustable tables, enabling work to be set at any angle between the vertical and the horizontal, dead stops at the last named positions being available. As has recently been pointed out by a writer in the European edition of the AMERICAN MACHINIST, it is often assumed that the only function of an upright drilling machine is to revolve and force the drill through metal, this assumption and severe competition among makers having the effect of hindering the commercial development of machines capable of standing up to hard, continuous and accurate work.

It is open to question whether the practice of babbitting bearings on such tools is not carried rather too far in America. I recently heard of a case where a prominent English user, after an extended experience of American drilling machines, is inclined to revert to British tools in which babbitting is not resorted to. It is curious to note the prominence, apparently perforcedly, assigned in American technical journalism to the subject of babbitting. To judge by one's reading there appears to be more attention devoted to babbitting, and curing troubles with "hot boxes" in one year in an American factory than would be necessary in three here. I am very possibly wrong, but that is my impression.

A point brought forward at the recent annual dinner of the Manchester Association of Engineers, by W. Crossley, of gas engine fame, is suggestive. Mr. Reynolds, the Principal of the Municipal School of Technology, had enlarged on the statement that the real cause of American and German supremacy in certain lines was not so much due to tariffs and artillery, as to superior general education, and Mr. Crossley replied that admitting, for the sake of argument, such a state of things, it was curious with what persistency the United States imposed a duty of 48 per cent. on machinery from Great Britain.

To see ourselves as others see us is possibly salutary. American opinion may or may not confirm the impressions of a Mr. Lawson, published by Messrs. Blackwood, on "American Industrial Problems." According to his statements American workmen are compelled by their employers to obey certain rules of life. They must be teetotalers; they must live in villages which the employer establishes for them; they are subject to a continued occult surveillance. "Confidential reports are made periodically on every employee. The careless maxim of some British masters that men may do what they like with their own time is never heard in the United States." Again, "In the workshops private detectives are introduced to find out what the men are saying and doing. The great Pinkerton has a detective service for this express purpose. One of his men may be hired as a fitter or mechanic, and he may be in the shop for months without exciting the least suspicion of his character. Every night he will send in a report of all he has seen or heard during the day." Trade unionists are watched with a jealousy which renders them powerless; if dangerous, they are "let up on deck," or, in other words, promoted. The Englishman will wonder, says one of our dailies, whether such a system can last, and will be inclined to ask in what respect this so-called freedom is superior to the servitude of the Russian or the German—to say nothing of the English worker.

Manchester, Eng.

[John Burns is reported by the press despatches to have said recently that the industrial condition here is "hell with the lid off." Perhaps he had been reading the book referred to. Except in the railroad service we know of no industry in which teetotalism is required. Except for the town of Pullman, Ill., we know of no case in which workmen have been compelled to live in a town provided by the employer, and the attempt there was long since abandoned. We know of no factory in which confidential reports are made on employees, and, while we are not, for obvious reasons, in a position to deny what the Pinkerton agency may or may not do, we regard the idea that the presence of a detective is a common thing in American factories as absurd.—Ed.]

Concrete-Steel Chimneys.

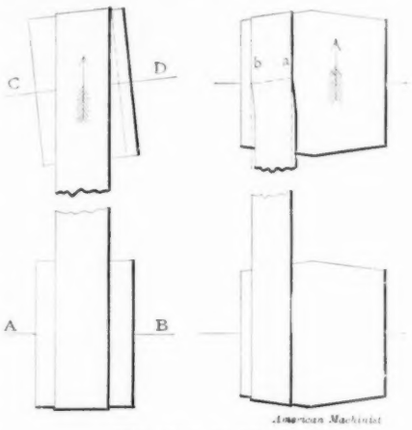
One of the interesting phases of recent progress in engineering is in the rapid increase in the use of concrete and in the intimate association of it with steel in construction. It would not be easy to determine whether steel or concrete is the more indebted to the other. In either case the world at large is the gainer. At Los Angeles, Cal., a large concrete-steel chimney has recently been erected, which is a favorable example of the adaptability and value of the new system of construction. The chimney is round and 180 feet high above the base, which is of special shape to provide for the flues which enter it from either side. The body of the chimney is 15 feet in diameter outside and 11 feet inside, with a finely decorative cap. The chimney was erected entirely by means of a scaffolding built inside as it ascended. The outer shell of the chimney is of three different thicknesses for the different hights of it, being 9, 6 and 5 inches respectively, while the inner shell also has three thicknesses, 5, 4½ and 4 inches. The inner shell ends 4 feet below the cap and is free to expand or contract independently of the outer shell. The cement is reinforced throughout by cold twisted steel rods, both horizontal and vertical, entirely embedded in it. The cap was formed by a series of blocks made on the ground and hoisted to position. The chimney was erected at the rate of 5 feet a day, the molds providing for this length at each setting, being filled before quitting time in the afternoon and hoisted to the new position the first thing in the morning. The details of the construction of this chimney were recently given in the *Engineering News* by Mr. Jas. D. Schuyler. Other chimneys have been erected in different parts of the country, and concrete-steel bridges and buildings also are now frequently heard of.

The Lead of Belts on Crown Pulleys and on Unparallel Shafts.

Our attention has been called to the following from the columns of a contemporary: "A very common question and one often discussed is whether a belt will run to the high side of a pulley or not. For instance, if two shafts are out of line, not parallel with each other, one side of the pulley must be farther from the opposite pulley than the other side of that pulley, therefore one edge of the belt is tighter than the opposite edge. Some men seem to think the belt would run to the slack side and off, but it will not. The belt runs toward the highest side for the very same reason that a belt will stay on a crowning pulley. The tight edge becomes, from being tight, the leading side of the belt, and the rest of the belt follows simply. If a rider wants to direct a bicycle in another direction, he turns the forward wheel in the direction he wishes to go and the rest of the machine follows. The direction of movement of a shaft out of line is indicated by the position of the shaft to the belt, and the belt simply follows in the direction indicated by the pulley: toward the tight side."

We regret to say that this is incorrect information. The matter is generally understood correctly, but a few are occasionally going astray upon it, and every few years, for the sake of the younger ones especially, it seems to be proper to give a little explanation. The sketches should be sufficient to show how a belt will lead in each case. In the left-hand sketch we have two shafts with similar straight-faced pulleys on each. If the pulleys were not of the same size, the result would not be different. The shaft *C D* is not parallel with *A B*, and our contemporary assures us that the belt would run to the right, when in fact it would run to the left, and would be off the pulleys entirely after a few turns of the shafts. We assume that the belt starts, as shown, in a correct position on the lower pulley. Then to run correctly on the other pulley the edge of it should lie in the direction of the dotted line, but instead of that, as the belt comes to the face of the pulley, each successive portion of it is farther to the left than that which preceded it. It of course leaves the pulley farther to the left as it runs off the other side and this of course will make it lead to the left on the lower pulley, and so on.

In the sketch at the right, the shafts being parallel, the belt would run wherever placed if the pulleys had straight or parallel faces. Suppose, however, that the pulleys are crowned, as shown exaggerated, and that we have a belt less than half the



THE LEAD OF BELTS.

width of the pulley and placed as shown. The pulley being larger in diameter where the right-hand edge of the belt travels than where the left-hand edge is, the right-hand edge of the belt will be carried along faster than the other edge. If, for instance, we started the belt with a line drawn square across it, that line would shortly become oblique, as shown by the dotted line, and the belt would be bent edgewise, as indicated and of course would run farther and farther to the right, the same operation being repeated on the other pulley. After the belt passes the place of largest diameter and begins to lap over on the diminishing side of the pulleys, then an opposing effect begins, and when the belt laps equally on each side it is kept approximately in that position by the equilibrium of the thrust of one side against the other. This thrust of the two sides of a belt toward the center is sometimes considerable, especially if the crowning is more than necessary. We once knew a double belt 24 inches wide which would tear out the rivets longitudinally through the exact middle of the belt and leave a considerable space between the two thicknesses of leath-

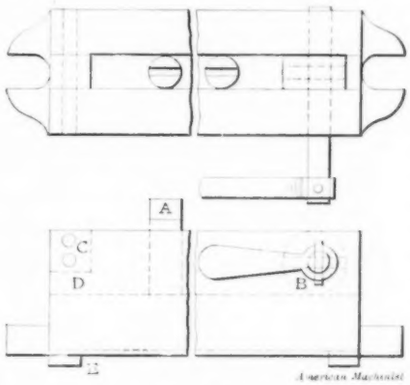
er. This demoralized middle of the belt, it may be supposed, did less than its full share of the power transmission.

Letters From Practical Men.

A Slotting Fixture for the Miller.

Editor American Machinist:

The sketch shows a milling fixture which I made for a job somewhat similar to that described at page 205 by F. C. Johnstone. The body is of cast iron, having the tongue pieces *E* let into a groove. *A* is the work—a round piece of steel re-



SLOTTING FIXTURE.

quiring one end slotted ¼ inch deep. The work is placed in the groove, as shown, and clamped against the stop *C* by the cam *B*. *D* is a space through which the cuttings are cleared away.

Rugby, England. TOOLMAKER.

Some Suggestions on Commutator Segments.

Editor American Machinist:

The article on casting commutator bars at page 328 interested me very much, and I would like to make some corrections on what Mr. Vickers seems to think is the prevalent method of making copper commutator segments. The following points are borne out by the practice of what is probably the largest copper foundry in the United States.

To begin with, I have never heard of a case where it was necessary to use split patterns and did not think there were any shops where such is the practice. The firm with which I have had connection holds about 9,000 patterns, none of which are split, and though they have numberless patterns sent in of odd bars which they do not hold in stock, I have never yet seen a split pattern for commutator segments, and hence cannot believe that such is the practice of other firms. The patterns are made with the opposite edges parallel, as shown in the accompanying sketch, though in some of the thicker bars a slight taper is allowed for drawing the pattern from the mold. In bars ⅜ inch and under in thickness the rapping alone is sufficient to allow the drawing of the patterns without any taper. As all commutators are bored and turned, this meets with no objection, and certainly is a great saving both in the initial cost of patterns and in the molders' time, as there are patterns to be drawn from but one-half of the mold, the other half being perfectly plain. In addition, the smaller patterns are generally carded so that the gates and patterns are all in one piece and may be drawn simultaneously. The side marked *A* in the sketch is placed on the board.

Mr. Vickers admits a variation in thickness of his castings due to the inclination of the molds, and though admitting it to be a fault, he seems to be unable to devise any method of avoiding this. By adding a riser at the other end of the mold and laying the flask horizontal, perfectly homogeneous bars are obtained of uniform thickness, as there is an equal head on all of the bars. No reputable concern would use segments having an admitted variation of anywhere near 3-100 of an inch. Only in rare cases have we been asked to cold-drop our cast bars and they give perfect satisfaction when assembled into the commutators just as cast. In the finished commutator the bars appear to be as uniform in thickness as drop-forged bars.

The old method of tumbling or rattling the segments to clean them is fast going out of use. A more modern way is to dip the castings in hot dilute sulphuric acid. The dilution is in the ratio of one to twelve, and the bath is kept hot by blowing live steam through it. This gives the castings a brilliant, natural color, and cleans out and exposes any possible flaws.

SOLID PATTERNS FOR COMMUTATOR SEGMENTS.

The castings are left in this solution about five minutes. The solution will not need to be renewed oftener than once in two weeks. E. B. NORRIS.

State College, Pa.

Editor American Machinist:

In the comments that Mr. E. B. Norris has kindly made on my article on casting commutator bars it seems to me that he has misunderstood my remarks concerning split patterns.

The article referred to carded patterns, and no elaborate explanation of why many bars so molded must be split was given, because I thought it would be perfectly plain to persons handling segment patterns, as they would notice the shapes that require such treatment. At the point where connection with armature is made many bars are thicker than at the shank or connection with body of bar. Consequently such bars must either be split or cored out under shank when carded.

When not carded, no segment will require to be split, because it can be withdrawn from the sand precisely as stated by Mr. Norris.

The remarks on variation of thickness were intended to direct attention to the importance of careful molding, which is necessary no matter how cast.

The article merely gives a general idea of one method of making such castings, and in no way exhausts the subject.

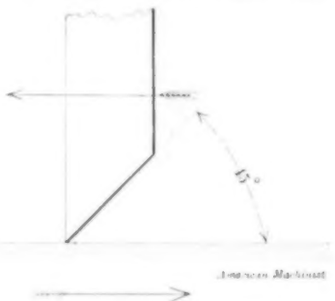
It is by the interchange of ideas that we learn, and so the suggestions of Mr. Norris will be welcomed by all practical men. C. VICKERS.

Angle of Cutting Tools for Brass.

Editor American Machinist:

The article by Mr. Danse, at page 341, was a most interesting one, and possibly quite a chapter might be written on "brass tool notions." It is brass tools and dies which cause this note, at any rate.

Mr. Danse says he filed the cutting face



ANGLE OF CUTTING TOOL FOR BRASS.

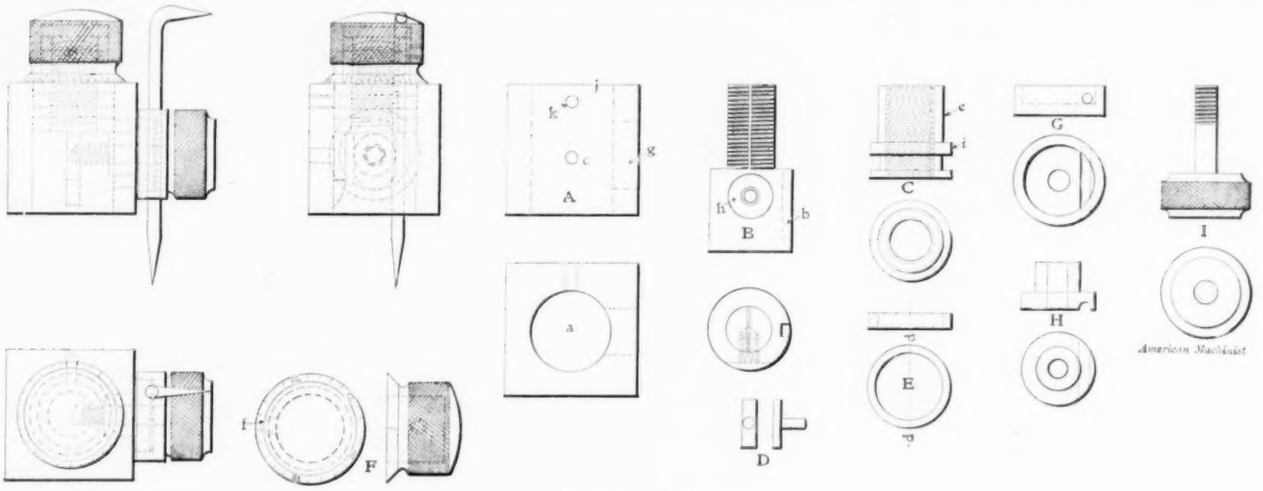
of a die back, while the backing face was filed radial. This may give satisfaction, but for general use I have found that both faces radial and *kept sharp* give the best results. The keeping of dies sharp is an extremely important matter, and especially on brass. A "hook" or "drag" tooth should not be introduced in a die in any case if it can be avoided, and especially on brass where the cutting plane of the tool should be perpendicular to the surface at the cutting point.

A company by whom I was employed at one time was introducing turret head methods in its works, and among other articles it was desirable to finish brass stuffing-box glands having large flanges. For some time these were chucked and faced with an ordinary tool in the cross-slide, no satisfactory tool being found to take a shaving chip on the face. After some experimenting, a flat facing cutter was made with an end clearance of about 45 degrees, and the results were most satisfactory. This cutter was used directly on the scale, no roughing tool preceding it, and it gave a very good finished surface. The secret of success appeared to lie in making the cutting face normal to the work at the cutting point, and having a large clearance angle. See sketch. P.

Surface Gage.

Editor American Machinist:

With regard to a surface gage described at page 349, by George Woodbury, of Toledo, Ohio, I show in the accompanying sketches a tool which I designed, for similar work, several years ago, and which I think is better than the one he describes, as I consider it impracticable to lap a hole to a shoulder, as is necessary in making the gage he shows.



SURFACE GAGE.

The body of the gage I made as shown at *A*; the block is ground and lapped on all sides and in the hole *a* after hardening. The plunger *B* is threaded (40 per inch) to the shoulder, and the threaded end is sawed to the shoulder and sprung open slightly, thereby causing it to always fit the nut shown at *C*. In the side of *B* is a slot *b* into which is fitted the head of the pin shown at *D*, the shank of which fits in the hole *c* in block *A*, the object of the pin and slot being to prevent the plunger from rotating. The ring *E* is hardened, ground and lapped all over except in the hole which is a very loose fit for the bottom of the groove in nut *C*; the side of the ring is a good working fit in the groove, and the outside is a driving fit in the hole *a* in the body of the tool. After the ring is completed it is broken into two pieces, as on line *d d*. The largest part of nut *C* is a loose fit in the hole in *A*; the stem *e* is a tight fit for the hole in the knurled cap *F* and the cap is further tightened on the nut by a small set-screw *f*. The scriber clamping device is composed of the two washers *G* and *H* and the screw *I*. The stem of washer *H* fits loosely in the slot *g* in block *A* and bottoms at *h* on plunger *B*. The assembling of the tool is quite simple and is accomplished in the following manner: Pin *D* is put in the hole *a* in the gage body with the shank in the small hole *c* and the head standing at right angles to the base; the plunger is next inserted into the hole *a* from the bottom with the threaded end up, care being taken that the head of the pin *D* enters the slot *b* of the plunger; nut *C* with the broken collar *E* in the slot is next screwed on the threaded end of *B* as far as possible, after which it must be forced into the hole in *A* until the shoulder *i* is flush with the top *j*, thereby bringing the broken collar opposite a set-screw at *k*, which can then be tightened if necessary. The knurled cap is next forced down to the shoulder of the nut and further tightened by the small set-screw *f*, and the plunger is then lowered by rotating the cap, until the spot *h* is opposite the slot *g* in the block, so as to allow the scriber clamp to be screwed into place. It is obvious that, as the thread of the plunger is 40 per inch and the cap *E* is graduated into 25 divisions, by rotating the cap either to the right or left the scriber will be raised or lowered as many thousandths of an inch as there are lines of the cap moved past a line on the top of the block *A*.

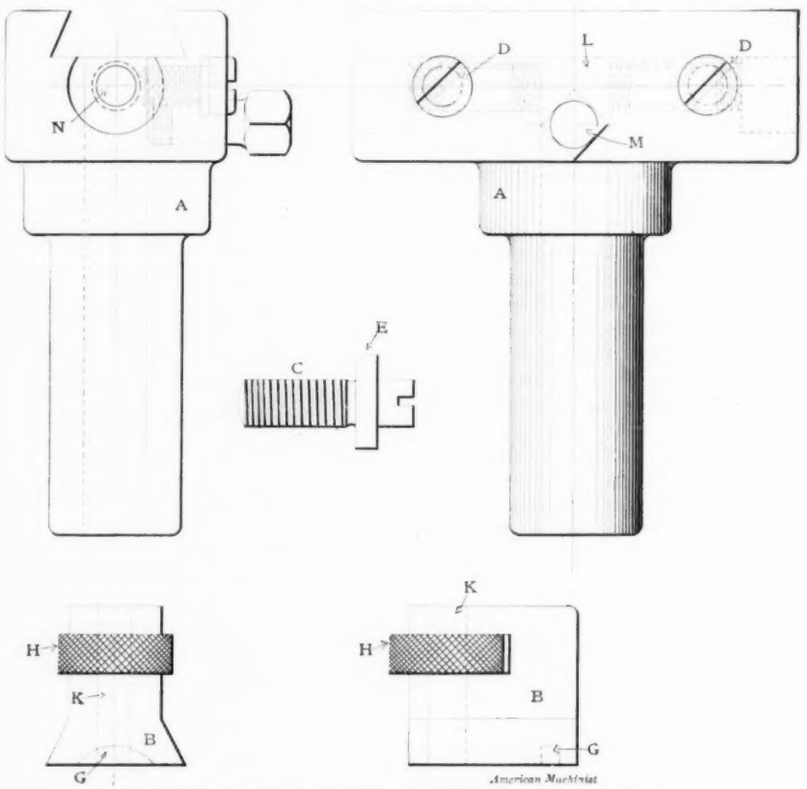
I have used this tool a great many times and have found it almost indispensable.

D.

Adjustable Knurling Tool for the Turret Lathe.

Editor American Machinist:

At page 491 is shown a knurling tool for the turret machine, which is all right for special cases, and good so far as it goes, but it does not go far enough. Made as shown it is suitable for one size only,



ADJUSTABLE KNURLING TOOL FOR THE TURRET LATHE.

and makes no provision for wear and the re-cutting of the knurls. According to my notion, tools of this description should usually be made with a limited amount of adjustment. The sketch herewith shows another form of this tool, made eight or ten years ago, which has performed very satisfactory service. The rectangular head of the holder has a dovetailed slot planed through, in which the two blocks *B* are made a neat sliding fit. These blocks carry the knurls *H*, adjustment to and from the center being obtained by means of the two screws *C* fitting tapped holes *N* in the head. The collar *E* on screw *C* fits into notch *G*, in block *B*. Set-screws *D* lock the adjusting screws when set.

The pins *K* are of tool steel, hardened. Set-screw *M* may be used to fasten a bushing to support the end of the piece being knurled, which bushing may be replaced when worn, or it may hold a drill.

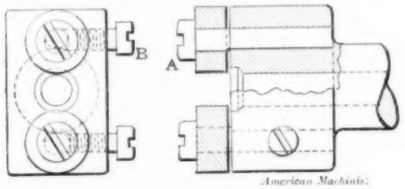
By using a drill in hole *L* it is possible to drill a hole in the center of the piece being operated upon, at the same time that the knurling is done on the outside; which, by the way, is quite a frequently occurring job. This, of course, saves, usually, the time required for a separate operation. In use, most of the pressure is back against the shank, and there is very little strain on the screws *C*.

C. L. Bailey.

A Knurling Tool for the Turret.

Editor American Machinist:

Noting what Mr. Parkes has to say, at page 491, about a knurling tool for the turret, I wish to say that we have used such a tool with our automatic screw machines, with a few changes, as shown by the sketch. *A* is an eccentric pin, which



KNURLING TOOL FOR THE TURRET.

allows for the knurling of different diameters with the same tool. The pin is held in place by screw *B*. The pin has a shoulder, which is concentric with the head, and is turned about .010 inch longer than the width of the knurl. We make these tools with either one or two knurls, using one knurl to get one cut and two to get cross or diagonal patterns. F. A. G.

That Small Pawl Jig.

Editor American Machinist:

I am not fully prepared to adopt Mr. Weekes' design of jig, illustrated at page 478. In the first place, I consider a cam in a jig an abomination, with a big "A," unless it is of the spring variety like the sketch, and then to be used sparingly.

With this sort of a cam the spring will compensate for irregularities in the blank forging or casting, as the case may be.

Mr. Weekes objects to binding screws. I would think in his jig, as there is nothing to hold the work down, the holes might be straight through or any other old way.

In regard to fitting bushings in the lids of jigs: We have not a few, but millions

SPRING CAMS FOR DRILL JIGS.

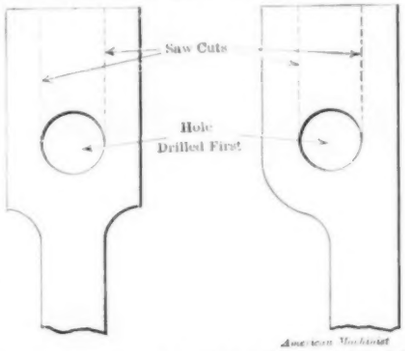
of them in this factory fitted in that very place. The holes in some parts have to be gaged from a finished surface, to shut out daylight, yet no particular difficulty is experienced. The binding screw which fastens the lid merely holds it down, while the slot fits the flattened post closely, making error impossible. Mr. Weekes calls a pawl a simple little thing, yet our pawls have to be finished and gaged so closely as to shut out daylight, as the least variation would cause the machine to record wrong. W. E. Callaghan.

Dayton, Ohio.

Uses for the Power Hacksaw.

Editor American Machinist:

I quite agree with Mr. Ball in his letter, at page 199, about the variety of uses that a power hacksaw can be put to. In our business we use a great many rods with jaw ends, for link motions, etc. At an early period we used to forge the jaws on the ends of the rods and then finish them by slotting. Then later we made the ends solid, and, drilling a hole at the inner end of the jaw, we slotted out the piece of metal left in. For the last few years, however, we have sawn this piece of metal out with two saws fitted in an ordinary power hacksaw, putting a distance piece between the two saws of nearly the exact



FORK ENDS CUT IN THE POWER HACK SAW.

dimensions between the jaws and just leaving enough to clean out with a smooth file. The sketch herewith shows what I mean and illustrates two different forms of rod ends in use. I may also say that for other purposes we have used as many as seven saws set in a frame at once.

Wm. Campbell Wilson.

Thetford, England.

Margins.

Editor American Machinist:

I'll never forget the time when Bill Russell got his pay doubled all at one jump. It's a tough yarn to swallow, because wages as a general thing have considerable inertia, especially on the up grade, as every fellow knows. Ten per cent. at a lick is about all you generally hear of, and 25 per cent. would almost take your breath away; but Bill had his pay doubled.

It was this way: Bill and I were chums. We were about the same age, and came into the shop about the same time "to learn the trade," and as there were no others in the shop of the same class we naturally hung together. All the arrangement made when we went into the shop was for us to go to work at whatever came along to do, and the Old Man was to pay us what we were worth. One thing I suppose the Old Man knew, and that was that whatever he paid one of us he'd have to pay the same to the other.

Well, we were getting $3.00 a week each, and we had been getting it so long that it was becoming decidedly monotonous. We began to feel that something would have to be done about it, and we agreed to work together for a raise. I suppose we organized a union, but we didn't know it. Our union was not for general purposes of aggression, but only to strike the Old Man for this raise. An embarrassing event delayed us for a time, and that was that our working hours were cut down without change of pay. The shop had been running eleven and a quarter hours a day and the time was changed to ten hours. This was about 1855, and the change, I believe, was in consequence of a New York State law, which went into effect at that time. All the same, we felt that it would not be the thing for us to go on as we were much longer.

We finally drew cuts to see who should tackle the Old Man, and it fell on Bill. He got a chance the same evening, as the Old Man was busy drawing a new crosshead when the rest of us quit. I hung around up at the corner and left Bill to his fate. I had to wait I suppose fifteen minutes and then I saw Bill come out of the door. He hadn't gone far before he started for me on the run. "Tecum," he said, "I've got my pay doubled, just doubled, and we don't get any too much at that. The Old Man said of course he'd have to give you the same, and that was his excuse for pretending to hold off; talked about slack times and all that; but I'm to get my double pay all right."

"Bill, talk sense. What do we get anyway? Doubled! If we get one and a quarter times what we've been having I

shall jump; but double! Bill, you're crazy."

"Well, we've been getting $3.00 a week, and now we'll get $3.50, and if that ain't just double for me then I don't know how to figure."

"There! it's just as I told you; fifty cents onto three dollars is just one-sixth, or sixteen and a string of sixes per cent. That's far enough from a hundred per cent. What's double got to do with it, anyway?"

"It's just as I'm telling you, all the same; it's double for me. Haven't I been giving my folks two dollars and a half a week right along, and haven't I been getting fifty cents a week? Now, if I get a dollar instead of fifty cents a week I'd like to know if my pay isn't doubled."

I've had to remember about Bill's doubled pay a good many times since those days. There is considerable in it, and there are a great many places where it applies. In that way I am thankful to say that I've had my pay doubled more than once, and that has given me occasion to think of it, and I've known a good many others to whom an advance in their wages of 10 per cent. at some time or other has been a doubling of the margin upon which has depended most of what made their lives worth living. Doubling the cream in a quart jar of milk, as we have it delivered to us in New York, would not, I suppose, add more than 10 per cent. to the total bulk, but it would make a vast difference in the satisfaction with which we would use it. It is especially on account of the margin that it behooves a fellow to make the best of himself always, and to see to it when he does his best that he gets for it what it is worth in the market.

I hardly know why it should be more necessary to advise the workman to look after his margins than to advise the employer to do so, but it seems to be. He is not so absolutely and entirely dependent upon his margins as the boss is, and I suppose that accounts for it. A fellow can live in some kind of a way, or postpone dying for a while, with very low pay, though he won't have much fun. With the employer it is different. He can't even keep alive except on his margins. The first of his receipts don't go for living at all, but for material, labor, power, maintenance of plant and all that, before the skimming for his share can begin, and, while he may get great gobs of cream at times, the amount of it may vary more easily and from slighter causes than we are always apt to think. We of course really know all this, but it is still well enough for us at times to remind ourselves of it. I believe it is well for us to keep constantly in mind the partnership idea. Each works not only with, but for the other, each should rejoice in the success of the other and each should be ready to accord to the other an equitable share. I would hate awfully to work for a concern that was not making money, and I think all right-minded workers feel the same way, and at the same time I should not think much of a boss who was not glad to see me getting along.

The employer's task of according to the employee his equitable margin would seem to be a simple one, and the employee is apt to so regard it. The only thing to do is to pay the man sufficient wages. To do this, however, the employer must conduct his business wisely and economically in every other detail of it or he will not have the money coming in in sufficient volume to warrant the equitable wages. Supposing him to be a manufacturer, the article he produces must be pretty well up toward being the best of its kind, and even then it must be advertised and pushed to be sure of having sufficient sale to keep the works busy. The details of manufacture must be so planned, all facilities for doing the work cheaply must be so provided and all the materials must be so bought that after all is done the workman may then get his proper share. It not infrequently happens that the employer really cannot afford to pay the men more than he actually is paying them, and the reason is that he is letting his workmen's wages leak out in some of the other details of his business. Where everything all around the works is looked after the most sharply is where the workman stands the best chance of getting good pay. The greater the sum of all the other cost of producing any article, the lower necessarily must be the wages of the workers.

Where the workman has a large control of the employer's margin of profit is in the economical use of his time. I have many times seen computations made, in the papers and elsewhere, of the losses resulting to the employer from the stoppage of the works for five minutes by some accident or incident, and I think I never knew of its being done correctly. The loss is generally taken as directly proportional to the time of stoppage, as compared with the total length of the working day. Thus if the shop is running ten hours a day, and if the stoppage is for an hour, it is generally said that a tenth of the day is lost, when in reality it must be an abnormally profitable business —a business more profitable than the average machine shop—which does not see its entire profit for the day wiped out by that hour's stoppage, and this simply because the business is not all profit, and that the profit whatever there may be is the first thing that is knocked off. This has no bearing at all on the question of the nine-hour day or the eight-hour day, and is not to be taken as an argument on either side of it, because when business is conducted on a short hour basis *all* the other conditions have to be compromised and adjusted to accord with it. Whatever the length of the working day, time lost in getting to work at morning or at noon, in stopping actual work before the whistle blows, or in running a machine slower or with finer feeds or lighter cuts than are necessary, or in making changes of tools, or in changing or setting work in the machine, or in not having tools ready and in good condition as they are wanted, or any of the other unnecessary and avoidable losses of working time, entail losses of profit and of wage-paying ability much greater than the actual proportion of time represented, as any fellow can easily figure out if he is desirous of seeing things correctly.

TECUMSEH SWIFT.

Jewelry Die Work.

Editor American Machinist:

I was very much pleased to see Mr. T. O. F. come forward at page 472 and exchange experiences on the sinking of small jewelry dies, and while I admit that it may be perfectly safe and practicable to "strike up" such dies cold, I still hold that better results are obtained if the die blank is heated before the operation. While the die without doubt would be serviceable for a limited time, it would certainly not show such endurance as one which has been sunk while hot. We have had a number of these dies in use for several years, and while I do not know the exact number, I think that at least 10,000 punchings have been embossed by each of them.

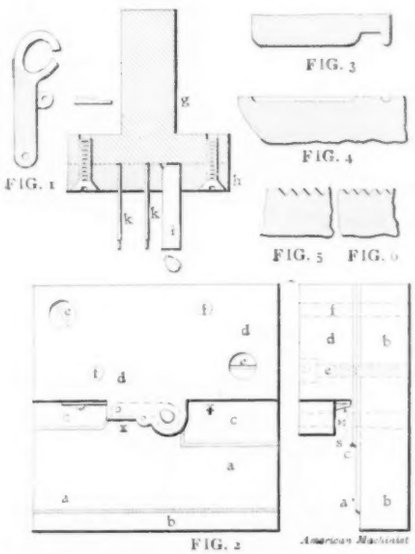
I have never found it worth while, when filing a hob of this kind to try to produce a perfect semicircular section, and I do not think that it is possible to do so. It has always been my practice to make small end mills of the desired shape from a piece of Stubs steel and finish the semicircular parts while soft. In a case of this kind, where the parts have to be of determined sizes, not alone in diameter but also in thickness, where a certain amount of metal has to be accommodated and no burrs allowed, nothing would be left for your correspondent but to polish out any defect of the shape, which would be liable to require hours of tedious work, as polishing of this nature, especially near the center of the polishing stick, proceeds very slowly.

It has never with us been necessary to reproduce a hob, excepting in cases where changes in the shape were made, because there is hardly any possibility of one's breaking or of losing its shape while sinking it into the red-hot die blank, and I have never even found it essential to retemper any after striking a number of dies, as the quickness of the operation does not seem to allow the heat of the die to transfer itself to the hob.

After a die has been used for some time it will be found that the punchings no longer round up completely. This is not because the shape in the die has been forced larger by the large number of blows struck upon it, but rather that the grit imbedded in the gold, German silver or other metal tears tiny scales from the polished surface, and when examined under the glass it will look very much like

the fracture of hardened steel. When a lot of gold punchings have been embossed, this grit, reddish in color, will be found all over the die and die bed, and it is very important that it should not accumulate in the bottom of the image, as it will prevent the punchings from rounding up. I agree with your correspondent when he states that any moisture on the punchings will have the same result, and care should be taken, therefore, to have punchings of this kind, which are annealed before embossing and are cooled in water, perfectly dry.

We make it a practice, when a die shows wear, to take a cut off the face on the grinder and then polish the die out again. To prove that only a limited number of shapes can be pressed into a cold die blank, I enclose drawings of an eye-glass clip, which is embossed in a similar manner. The clip, made right and left, is shown enlarged in Fig. 1, the cross-section at the right showing the V-shaped



JEWELRY DIE WORK.

grooves of the surface which presses against the wearer's nose.

Fig. 5 shows these grooves as they should have been formed by the hob, while Fig. 6 demonstrates the result of several blows on the heated die blank. Every successive blow brought the image deeper, but the grooves would not form and it was necessary to finish them by scraping, and as this deepened the grooved portion considerably, the rest of the impression had to be sunk to the same level by hand.

Fig. 3 represents a cross-section of the hob, and it will be noticed that the oval, inside shape has been sunk much deeper than necessary. As one end of the oval is part of a perfect circle, a hole of the proper diameter was drilled and the rest of the oval was worked out by chucking short pieces of round files in the drill press chuck and holding the hob in an old chuck, which is kept around the bench for sharpening punches.

The die and punch, Fig. 2, used for perforating the oval as well as the two rivet holes before the punching is embossed, might be of interest.

The die proper *b* is made first and hardened. The oval perforating punch *i* is made next in the usual manner and also hardened. The tool-steel guide or stripper *d* is the next thing in order, and is drilled and counterbored for screws *e e* and fitted tightly with dowel-pins *f f*, which should fit loosely, yet without play, in the die *b*. The stripper is then screwed to the die, and the holes for the small round punches *k k* are drilled through from the back of the die. These holes are afterwards reamed to the body-size of the punches. The oval is now scribed on the stripper from the back of the die; the stripper is taken off and the bulk of the metal is removed by drilling. The stripper is again screwed to the die, and the punch *i* is used as a broach, also through the back of the die, always filing after having struck a light blow with the hammer. Every blow on the punch *i* should be dealt through the back of the die, because there is a strong tendency for the punch to work out of position if this is neglected. When the oval has been worked through in this manner a perfect alinement will have been obtained, and the stripper may now be relieved at the various points *x*.

PLAN OF SUCTION PIPE.

The gage plate *a* is made next, by inserting it between the stripper and the die and working the perforations through the back. The plate is then removed and the sample clip is located on top by inserting the various punches through the sample clip and scribing the outline on the plate.

To facilitate the finding of the opening in the gage-plate by the operator, a second, or guide-plate, is inserted between the gage and the stripper. This is an exact duplicate of the gage-plate, though somewhat thinner, and is open in front as shown. It enables the operator to locate blanks by simply sliding them along the beveled opening until they drop into the gage-plate.

A small, twisted, flat spring makes it unnecessary to remove the punching after it has been perforated. As the punches ascend, the punching compresses the spring slightly, and as soon as they leave it this is thrown outward, clearing the die.

The cast-iron punch-holder bodies *g* are kept in stock. The punch-holder plate *h* is made from machine steel and is treated in exactly the same manner as the stripper. The punches *k*, *k* and *i* are riveted slightly in the back, to keep them from pulling out, and should be hard as far up as possible, as it has happened that the soft portion in the punch-plate *h* has been telescoped, thus enlarging the holes.

FRANK GREINER.

Action of Air Suction at Different Openings.

Editor American Machinist:

About one year ago, while working about some automatic cheroot machines in the testing room, the boss in there told me something which I considered remarkable, and what Mr. Norton says, at page 469, about the size of the branches from the main pipe, which conveys dust from emery wheels, prompts me to write this.

He says: "The nearer the emery wheel is to the fan the smaller should be the pipe that conveys the air from it," and *vice versa*.

Now, these machines were so arranged that a fan produced through a set of pipes suction thro' a die head on which was placed the leaf to be cut for a wrapper—also suction on a head to carry the leaf. The suction had to be very closely regulated, so just above where the branch pipe joined the machine a slide was arranged to regulate the air for that machine. On the diagram I give approximate sizes of pipes and distances.

The machines were similar and connected in precisely the same way.

The *remarkable* thing was that the machine on No. 3 pipe would work with the suction *half shut off*, while at the same time No. 1 *must be on full*, and No. 2 would be midway between them as to opening.

One hundred machines were tested and sometimes No. 1 machine would not work till moved to No. 2 stand.

When the pipes were free I have placed my hand over the opening in succession and felt the great difference in pressure. This phenomenon can probably be explained by an interference of air currents; and it somewhat resembles that common experiment in natural philosophy books, of trying to blow a piece of cardboard off the end of a spool, which I suppose is familiar to most readers of this paper.

CHEROOT.

Drilling and Reaming Steel—Welding Tool Steel.

Editor American Machinist:

Tool steel can be drilled much easier dry, without oil. Oil is necessary for tapping, and tallow mixed with graphite is the very best lubricant for reaming wrought iron or steel. Those who have not used it will be astonished at the absence of chattering, and the sleek cutting of reamers with such lubrication. Technically, cast tool steel cannot be welded.

A piece of tool steel polished across a weld shows a film of iron between, the surfaces being decarbonized before uniting. A tool having a weld in a cutting edge will not stand—the film will wear away leaving a gap. A piece of tool steel welded will not stand forging, but will come apart when worked, owing to the softness and weakness of the film.

During the Civil War and before, cast-iron guns were bored with very large drills. These were usually made by welding two pieces of steel on an iron slab, the pieces lapped and welded at the point. These drills invariably came out with a groove or hole worn in the most vital part. Such a drill did not cut; it would only tear and would only work at all in deep holes by frequent grinding, and owing to the sponginess of the iron at the center, and by inordinate pressure.

C. W. CRAWFORD.

Another Kick from the Draftsman.

Editor American Machinist:

I haven't, as yet, had anything to say about the trials of the draftsman, although I have read with considerable interest the letters on the subject which have appeared in the columns of the AMERICAN MACHINIST. Now, after perusing the kicks of other draftsmen, I wish, with your permission, to register one of my own. I want to kick about the man with the bum free-hand or off-hand sketch; he's the fellow that worries me. Not that I object to shop sketches in general—in fact, quite the contrary, when the sketch is a neat one and clear enough to give a correct idea of the piece or pieces it represents; it's the other kind of sketch that troubles me. Sometimes it's one of the shop foremen, sometimes a toolmaker, then again it's someone outside of the shop who comes along with one of these off—yes, decidedly off—hand sketches of some device that's wanted, and then I have to straighten out this sketch and make something from which the men can work.

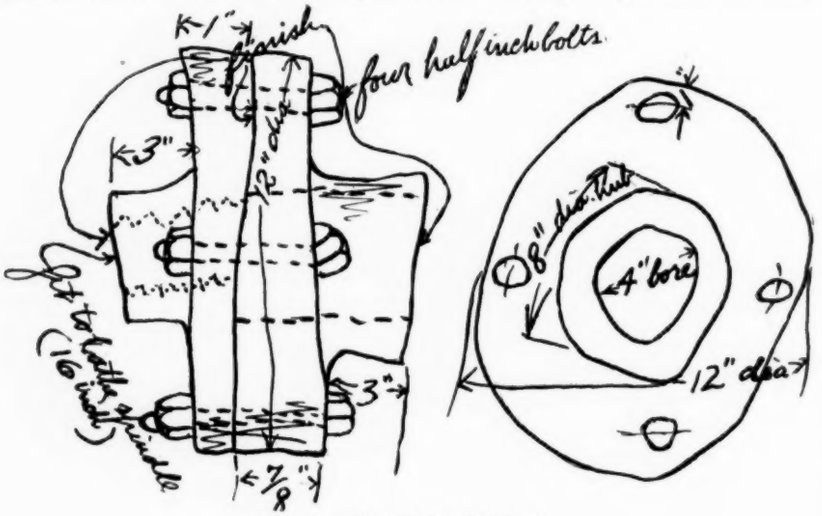


FIG. 1. THE SKETCH ARTISTIC.

Each week as I look over my copy of the AMERICAN MACHINIST I cannot but admire, along with the other features, the neat line engravings with which different articles are illustrated. Sometimes I catch myself wondering, however, if some of the drawings and sketches from which the cuts are made do not receive considerable doctoring after they leave the hands of the contributor and before they go to your engraving department. For, you see, at our place we get all sorts of things to do, and drawings, sketches, combinations of marks of all kinds come in, and also many ideas directly from the shop men and foremen; and occasionally the ideas are so crudely sketched that an intelligent understanding of them is out of the question without a long explanation, and oftentimes that doesn't help matters appreciably. Still, those who are not able, for some reason, to make a sketch that is intelligible do not bother me half so much as do those who are both able to and actually do, at times, make excellent sketches, but who generally, either because of laziness or carelessness, send in sketches that no man can possibly read "in the original."

Now look at this picture, Fig. 1, of a face-plate fixture; isn't it elegant? Just see those lines of beauty, those graceful curves and bunches made by the crazy swing of a hurrying pen handled by a pushed-for-time individual. The fixture is simple enough, and even with this artistic sketch we shall, of course, be able to build it. However, it's advisable to redraw it and add a few figures before it goes out to the shop men, and this might have been avoided had the man behind the idea spent a few seconds more in putting it on paper. It's this sort of thing that saddens me; especially so when the device illustrated in this same artistic manner happens to be a little complicated and is therefore worthy of a decent lay-out, or at least of a sketch having one or two lines which are somewhere near correct.

Now that I'm on this kicking job, I'm going to say a few words about some of my friends (?) who, when making sketches, whether free-hand or with the aid of instruments, make neat appearing ones, but always manage to leave out enough of the important lines to make the sketches look like all sorts of things but those they are intended to look like. The

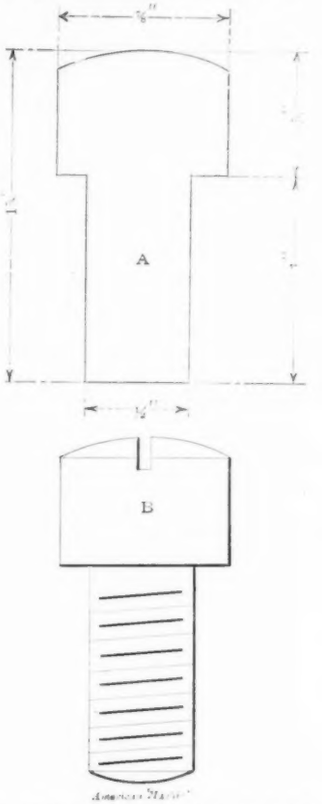


FIG. 2. TWO WAYS OF SHOWING A SCREW.

sketch at *A*, Fig. 2, is an illustration of what I am driving at. The man that made that got on most of his figures, and even gave the over-all length, but, however, omitted to give the thickness of the stock; for of course it's meant for some kind of a templet. Not a templet, you say? A screw? To be sure, when you put on the cross lines and the lines representing the threads and slot the head, all as indicated at *B*, then it's easy enough to see what's wanted. But if the outline at *A* doesn't represent a templet to be made of sheet metal, then my glasses need changing, that's all. At *C*, in Fig. 3, is shown the work of another sinner who is too lazy, or something else, to complete his sketches before sending them in. A pair of chuck jaws these? Sure. Don't you see those special jaws inside for holding the work? Some odd-shaped piece, it is, that can't be held in the regular jaws. After investigation, however, you find the sketch should have been made about as shown at *D*, and that it represents something entirely different from chuck jaws. Of course when such parts as these are shown in their proper positions in a drawing of some tool or machine there's little chance of mistaking the set-screw for a templet, or the odd-shaped bushing for a pair of chuck

jaws; but whether they are shown by themselves or in their working positions there's no excuse, so far as I am able to judge, for leaving out the few simple yet necessary lines that serve to identify the part.

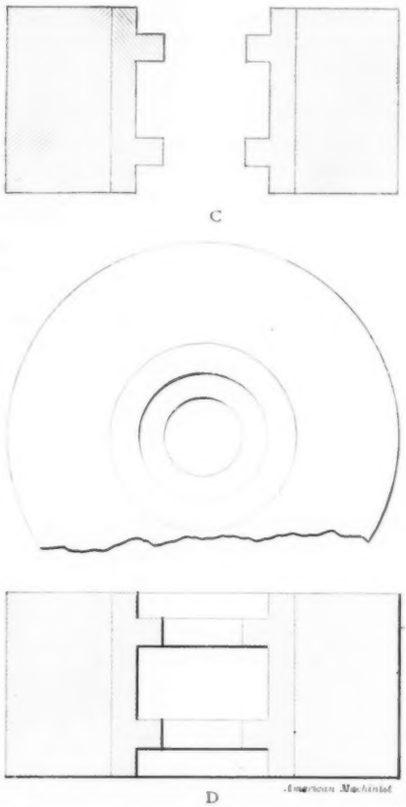


FIG. 3. TWO WAYS OF SHOWING ANOTHER JOB.

This growl about the man with the free-and-easy sketch or drawing is stringing out somewhat longer than I originally intended it should, but I can't drop the subject without mentioning still another peculiarity I find in many sketches that

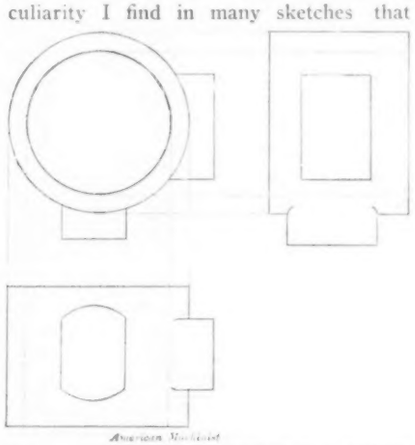


FIG. 4. THE SKETCH WITHOUT THE CENTER LINE.

come my way. Fig. 4 shows what might be called the center-lineless type of sketch. It seems to be so much easier for the fellows that make such things to tie all the views together by outside lines than to draw a couple of center lines and let it go at that; and the sketch always looks so much better, too (to the man that makes it).

A friend of mine remarked to me the other day, when looking over a mess of lines, most of which had been made in an off-hand manner, and as a result didn't seem to start anywhere in particular or end a bit more definitely: "The idea may be all right, but what are you going to do with the alleged drawings?" That's it; what *are* you going to do with them? Draw them over, I suppose.

There are too many such drawings about our shops; we want pictures, sketches, drawings, call them what you will, that will look, in a general way at least, something like the work they are supposed to represent. Not that they need be true to scale, neither is it necessary that straight edges be represented by absolutely straight lines, nor work with circular outline shown in plan by an absolutely true circle; but some approach to the correct shape of the work is desirable, as is also some idea of proportion between the various parts. What is wanted all about the shop is willingness as well as ability to sketch in a neat and decent manner and to show things somewhat as they are, or as they are to be when completed; willingness and ability to draw, say, an outline of a coupling bolt, that will look as much like that as it does like a wood screw; or a picture, say, of a face-plate, which will look near enough like the real thing so that no one will ever have an excuse for mistaking the plan for that of a fried egg or an oyster shell.

L. McANDREWS.

Time Saving and Encouraging Little Things in the Shop.

Editor American Machinist:

Just now I want to write a few lines with "little things" as my text. Of the "little things" some I have missed, others I have seen, and still others I would like to see.

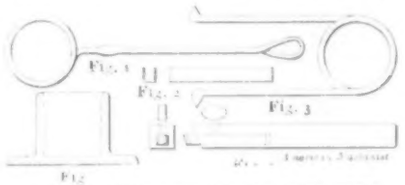
One that I missed was in a large shop where an elaborate system of time and cost keeping was in use, and where a large clerical and engineering force was employed to conduct the business in the most up-to-date manner. I missed it at a drill press, where a man was countersinking rivet holes in a number of plates. I didn't count the holes, but there were at least 150 in each plate, and perhaps a dozen or fifteen plates. He had a countersink drill in the machine and a rivet in one hand, and by two or three applications of the countersink to each hole he was doing a fairly good job; but, oh, how I did miss that little stop on the drill spindle that would have produced uniformity and reduced the time and effort required, and I am inclined to think that if that business has many little leaks like that the stockholders are missing something, too.

No doubt there are many shops in which expensive special tools are built to reduce the costs of operations, while numerous simple and comparatively inexpensive but efficient helps to smooth running and large output are almost entirely ignored. There are indeed many of these apparently insignificant little appliances which do so much toward making work more pleasant by easing and quickening it that those accustomed to work where these are furnished feel quite handicapped where they are lacking.

The swab shown in Fig. 1 for cleaning the center holes in lathe spindles does not represent a large investment, yet few mechanics having used one would like to go back to using their fingers or to "screwing" a piece of waste or a rag in the hole. The illustration shows it made of heavy wire soldered at the joints, and a rag drawn through the eye completes it ready for use. We place one at each machine and stamp the number of the machine on the shank.

Fig. 3 illustrates the old but efficient thread cleaner for chucks and face-plates, and, judging by its absence from most shops, it is not nearly as well known as it deserves to be.

Fig. 5 shows a simple holder for grind-



LITTLE HANDY THINGS FOR THE SHOP.

ing the square cutters used in lathe and planer tool-holders. One of these kept at each emery wheel facilitates the grinding of these cutters. Tool-holders are now almost universally used, and to get the most out of them the men should be supplied with a practically unlimited number of cutters and to grind one over from one form to another or to grind one up at both ends should not be necessary or allowed. We break these cutters off, roughly grind them to round nose form, harden them (using high-speed steel) in quantities and place them in the toolroom from where they are handed out upon request. On much work the tool-holder may be left in the tool-post of the machine and only the time necessary to change cutters need be lost, grinding one cutter while another is under cut.

Another quite useful addition to these tool-holders is shown in Fig. 2. It enables the holder to take smaller cutters than its regular size, which often is desirable.

Fig. 4 shows a cast-iron oil cup which we scatter over all the benches for dipping taps into when tapping by hand or at the drill press.

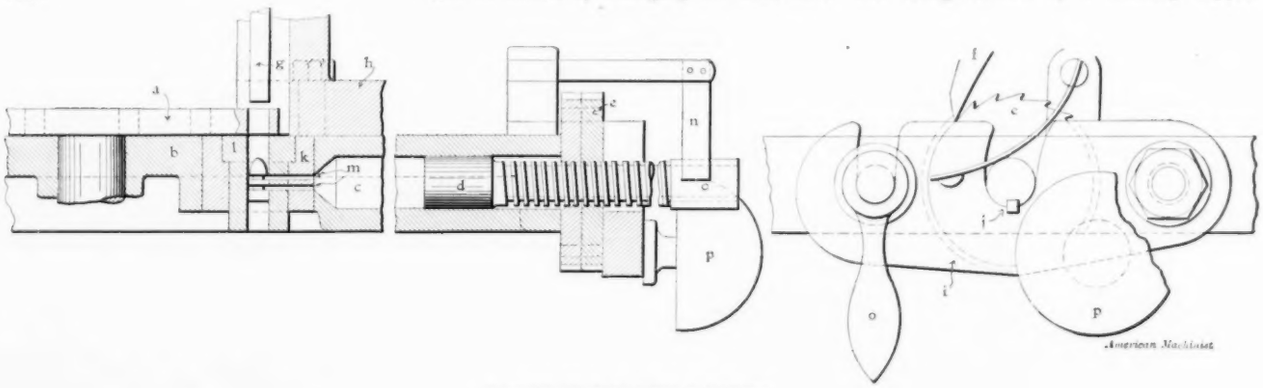
Now add to the foregoing articles suggested a sufficiency of chalk, waste and wiping rags, for each man a time-card board fitted with a spring clip and having a lead pencil fastened to a string, a brush at each machine, brooms within easy reach,

a clock and calendar in sight, separate oilers containing machine and thread cutting oil, soap suds and kerosene oil, efficient lamp brackets, extensions for the electric lights, an *individual* dish of warm, soft water for each man at quitting time, and a good place to hang clothing, and I think we'd have a shop which, with the accompaniment of fair treatment, would, by good men, be considered a desirable shop to work in. CORNEIL RIDDERHOF.

A Greasing Operation in a Cartridge Shop.

Editor American Machinist:

While reading the description of that wax press which R. P. King shows at page 488, I had to laugh; not at the press, however, but at something it brought to my recollection. That press reminded me of the greaser we used to run in the cartridge shop I was writing about some little time ago, and I never can think of that greaser without thinking also of the way Bill, the machinist, used to cuss when one of the boys broke it. And so far as I can remember, none of the boys ever ran the machine without at least one break-down to his credit, and most of them had several.



SECTION OF GREASING MACHINE.

Now a greaser, as everyone knows who has ever spent any time in a cartridge shop, is a machine for greasing certain kinds of bullets or balls before these are loaded in the shell; a machine for forcing tallow into the shallow circumferential groove or grooves formed around the bullet in a previous operation, usually called "creasing." In the shop in question the greasing operation was performed in a machine arranged in somewhat the same order as a small punch press. At the front was a feed dial with holes for the balls, which dial was rotated by ratchet wheel and pawl to bring one bullet after another over the greasing die and under the punch. The bullets were fed to this dial by a boy operator, who generally camped out in a comfortable chair at the front of the work table and took things as easy as he could without letting too many empty holes pass him. A portion of the feed dial will be noticed at *a* in the sketch, and directly beneath, at *b*, is the body of the machine itself. As this sketch is merely from memory, the mechanism is not shown complete, but I give enough of it to illustrate the principle of the machine. Casting *b* was drilled out from the back, the hole *c* (about 1 inch diameter) forming a chamber in which fitted the head of a square-threaded screw *d*, fed by a nut *e*. The nut was really a pair of ratchet wheels (right and left) fastened together and threaded to suit the screw. To operate the nut a pawl *f* was provided, carried by an arm actuated by the main arm which moved the punch *g* up and down, this punch being carried by a ram which worked in a vertical guide *h* bolted in place at the rear of the dial. Back of ratchet wheel or nut *e* was a good, husky piece of metal, shaped very much as shown at *i*, which backed up and took the thrust of the nut as it rotated. A key *j* fitting a spline in screw *d* prevented the latter from turning with *e*. At the front of chamber *c* was a ring *k*, and in this the bullet die *l*. Both were drilled through from the periphery as indicated at *m*, the holes in the two members being in alinement. Die *l* was arranged to turn slightly back and forth in its holder at each stroke of the press.

The machine being set up for a certain size of bullet, by changing the dial, dies, punch, etc., and the screw *d* being out of its position in the chamber, a stick of tallow, looking for all the world like one of the candles your grandmother used to make—excepting, of course, it had no wick—was slipped into the chamber. The feed nut was at this stage of the game up against one of the heads of the screw, the candle—perhaps 12 inches long—leaving just space enough at the rear end of the chamber for the screw head to enter, the ratchet wheel nut then striking against the finished surface at the back of the machine. Spring *n* was, of course, lifted to clear the screw as the latter was slipped into place; and block *i* was swung up into position as shown and clamped by the handle *o*, distance pieces at the back of *i* preventing it from binding against *e*.

When the machine was started the pawl-actuating nut *e* was allowed to run the screw up hard against the grease and force this into the die before the work was fed under the punch. Balls then being dropped into the dial *a* were brought one at each stroke of the machine—under punch *g* and forced down into die *l*, the grooves in the work coming, as shown, opposite holes *m*. Grease was forced by the pressure of the screw, through these holes and filled the bullet grooves, die *l* turning at the right time to cut off the grease flow and prevent more than the desired amount entering from chamber *c*. As the next ball was forced down by the punch, the ball already greased dropped clear of the die and the latter turned back to its previous position, again opening communication between the tallow supply and the grooves in the work. This machine worked very rapidly, and yet after a little practice the operator had no difficulty in keeping up with the feed dial; however, for one reason or another empty holes now and then would pass under the punch.

As the feed screw could not be seen from the front, a bell *p* was provided for notifying the operator when the screw had run in as far as it was safe for it to go. This bell was struck by the lump of metal soldered to spring *n*, the latter slipping off the end of the screw as it was fed along. The feed screw, it will be noticed, was made with two heads—the head at one end being formed by a bushing slipped over and pinned on to a reduced portion of the screw; it has already been explained that the ratchet wheel *e* was double. Now, when the screw had run its course and was removed to admit a fresh stick of tallow, instead of running the nut back to the end from which it started, the whole thing—screw and nut—was simply turned end for end and the other head inserted in the grease chamber, the other half of the double ratchet being then engaged by pawl *f*, this pawl being made, of course, only half as wide as the wheel it actuated. Now, as this screw was reversed there was always a lot of tallow adhering to the end last in use, and this was supposed to be thoroughly wiped off before starting up again. However, the operator would sometimes be a little careless in cleaning the end and when that end passed under the spring (the feed being very fine) the latter would slide slowly down over the end, and, owing to the tallow encountered there, would come to rest easily and without a sound, on the bell. In about two minutes trouble would be due; for when that

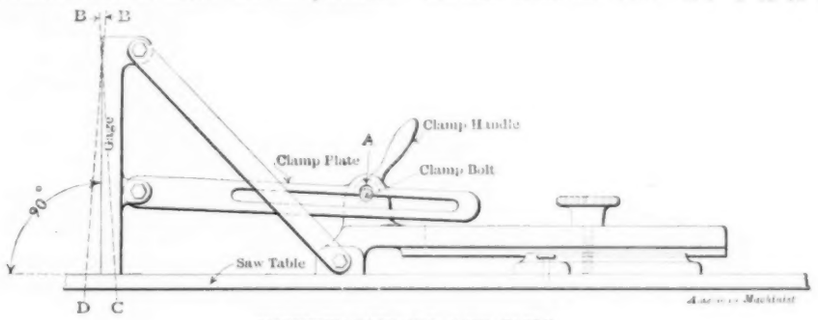
screw struck bottom there was something doing. Sometimes the studs holding block *i* were shoved off; sometimes the block itself broke; whatever happened it was right at this point that Bill commenced to cuss and say hard things about kids that went to sleep on their job. And I don't know, at this time, as I can blame him very much either. It strikes me, however—although it never occurred to me when I was one of the boys who had to run the machine—that with a very little ingenuity he might have devised some means for automatically releasing that ratchet feed when the screw had nearly run its limit.

S. F. ARTHUR.

Improved Gage for Saw Table.

Editor American Machinist:

The sketch shows a saw table gage or fence which, like others, had one bad feature; that is, there was no provision made for setting the gage at right angles to the table. This has caused a large amount of work to be spoiled, careless workmen often leaving the gage like *B C* or *B D*.



IMPROVED GAGE FOR SAW TABLE.

To overcome this trouble I made a new clamp plate with a notch at *A* to fit over the clamp bolt; when in this position the gage is at a right angle with the table. When the clamp plate is raised so that the notch is above the clamp bolt, the gage is free and may be set at any angle wanted.

JOB SHOP.

Inclinometer and Indicator.

Editor American Machinist:

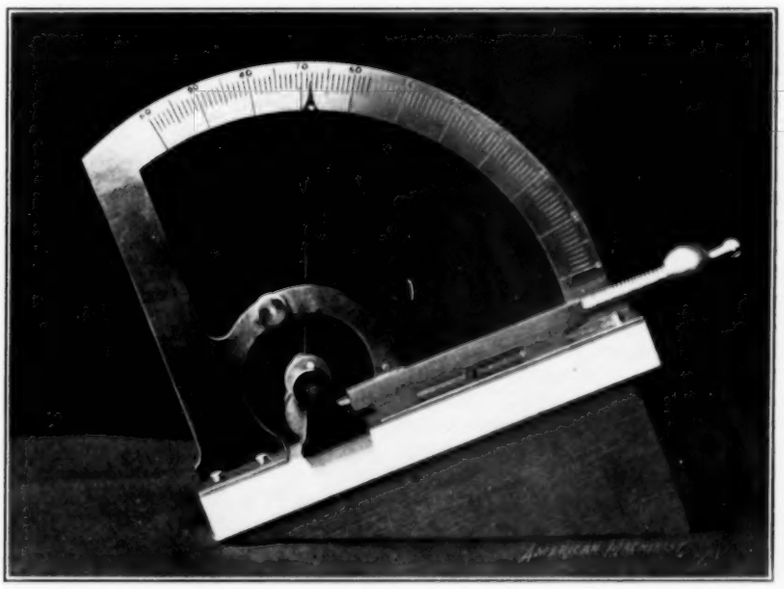
The accompanying photograph shows a simple and useful tool which I have just made and which can be used as a level, as an indicator, and for getting the angle of an inclined surface. The tool is graduated at each side, one pointer serving for both sides, as the top part of the pointer or hand is double and the quadrant passes between the two points; thus it can be easily read from either side. The pointer is fastened to a shaft, the ends of which are pointed; on the bottom is fastened a weight which always keeps the hand vertical, and when the tool is placed upon a surface to see if it is level or at an angle, the hand shows it at once, or rather after a second or so, for it vibrates a little. The test indicator, which I have added to the base, has at the end a hardened wheel; a coiled spring keeps the plunger away from the weight at the bottom of the pointer. When this indicator is used, it is pushed against the work, and the rod, pushing against the weight, moves the hand in the direction of 0 on the quadrant, the weight of the tool holding it. A movement of 0.001 inch causes the hand to move from one line to the next. You will observe in the photograph that there are pins or stops which keep the hand from striking against the quadrant; also a screw to lock the hand so that the tool can be carried about.

JOHN H. TORNEY.

Why Should Mechanics be Required to Give References?

Editor American Machinist:

Of what good is a reference? Why do advertisements in the "Help Wanted" columns contain the legend: "State references, salary expected, etc."? Why are not men taken on trial? It's "a 10 to 1 shot" that if a man is hired for a certain position, and his work falls short of the requirements of that position, his pay will be stopped, in spite of references. There



INCLINOMETER AND INDICATOR.

are few machinists who are not striving to better their condition by applying for positions with more money as a consideration, and the result is, "many are called but few are chosen."

There are thousands of expert mechanics who are qualified to hold an executive position, but who are practically tied down to their present jobs. Why? Because of this arbitrary method of advertising.

The manufacturing employer says: "We have an opening for a foreman in our works, and we must know whether the applicant is capable of holding down this job, before we hire him." Nonsense! Does the employer ever think of how "references" are procured. What is written as a recommend is usually the product of friendship.

Have the readers of the AMERICAN MACHINIST ever received many voluntary recommendations? Let me cite a case in point: An acquaintance of mine answered a certain advertisement in the "Help Wanted" column. The advertisement in question contained the usual "references required." This friend had "nary a reference," but he wrote just the same. After detailing his qualifications for the position, he plainly stated that he had no reference *but his work*, and that he had been with his present employers for ten years; was willing to come on trial for one month; at the end of which it was obvious that they could easily verify his stated qualifications, and if they were dissatisfied they could part. There are a great many machinists that are in my friend's position. Their present employers have a peculiar interest in keeping them year after year. They do not feel like quitting for the difference of a few cents on a day's wages, and to get a job that pays for the change requires the reference. Mr. Editor, it may be possible that there is a solution to this advertisement business. We as machinists would like to know why we can't be taken on "probation." Perhaps the employer can give us a valid (?) reason. I for one would like to hear "the other side."

TOLEDO.

Making Small Piston Rings.

Editor American Machinist:

From time to time you have published articles on the making of accurately fitting piston rings. As the sketches were generally of large rings, and the small ones such as are used on modern automobile engines, seem to be neglected, I send you drawings of tools for these which I designed and used with great satisfaction.

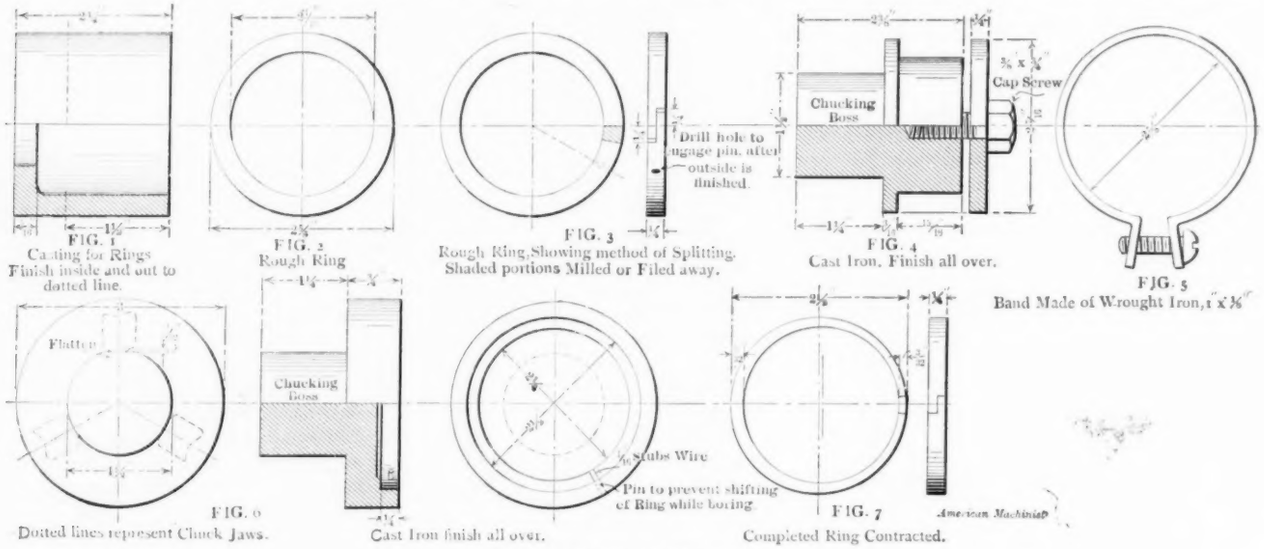


FIG. 1. Casting for Rings. Finish inside and out to dotted line.

FIG. 2. Rough Ring

FIG. 3. Rough Ring, Showing method of Splitting. Shaded portions Milled or Filed away.

FIG. 4. Cast Iron. Finish all over.

FIG. 5. Band Made of Wrought Iron, 1" x ⅛"

FIG. 6. Dotted lines represent Chuck Jaws. Cast Iron finish all over.

FIG. 7. Completed Ring Contracted.

MAKING SMALL PISTON RINGS.

The small engines require very accurately fitting rings in order to produce a good compression and to get the full benefit of the explosion. I find that, even among the best machinists, there exists a wonderful amount of ignorance concerning the proper construction of piston rings.

Referring to the drawings, Fig. 1 shows the casting from which the rings are cut. It may be made of any desired length, but should be strengthened where the chuck grips it, to prevent springing. I accomplished this by ribbing the chucking end. The iron must, of course, be good, and only sharp tools should be employed in roughing and cutting off. By using a dull parting tool, the metal is crystallized sufficiently to cause breakage when springing the rings into their places in the piston.

Fig. 3 shows a method of splitting which will prevent leakage indefinitely. Rings that are merely sawed apart will not remain tight after slight wear. The portions shaded are removed, and all rings should be the same.

After the rings are split, they are placed in the band, Fig. 5, and sprung together until the edges meet. In this position they are securely clamped on the arbor or hub, Fig. 4, after which the band is removed. My pistons required three rings, and I made this device to turn four at once. As will be seen, it is a simple affair, which is held in a chuck. After the rings are fastened by clamping, they should be turned *exactly* the same as the cylinder bore, and polished before removing from the arbor. It is evident that when they spring open they are no longer true circles, but when sprung together, as they are in the cylinder, they are absolutely true and round, insuring a good fit.

To equalize the springing tendency of a good ring, it is made thickest at the point opposite the split. To accomplish this, I made the chuck Fig. 6. This is also a simple affair bored out to receive the rings when they are sprung together. That is, the chuck is bored to the same diameter as the cylinder bore. To produce the desired eccentricity, the chucking boss is flattened, as shown, and then held in a three-jaw chuck, thus swinging the rig off center. The split end of the ring must go just opposite the flat place on the boss. It is also necessary to pin the rings, as shown, to prevent movement while turning out the inside.

After the inside has been bored to size, the ring is finished. Upon removal it will be found to be uniform in its spring and an accurate fit in the cylinder. The rings are then fitted to their slots in the piston and sprung into place.

I never had a ring break in service. The jigs are very simple and inexpensive, and, as they are held in a chuck, they require no troublesome bolting to face-plates, and a ring may be given any degree of eccentricity by varying the flat on the hub of the chuck, Fig. 6.

I have used tools of this type for rings from 2 to 6 inches in diameter, and always with success. Any of your readers who have had trouble with leaky rings will avoid future annoyance if they make them in the manner I have described.

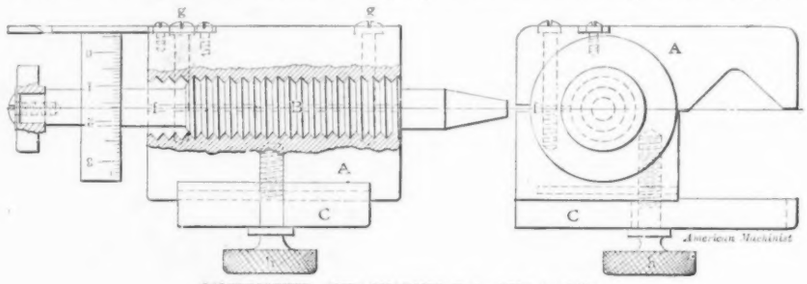
The rings shown in the drawing were used in a single-cylinder four-cycle engine running at 2,000 revolutions per minute and developing at that speed about 2½ horse-power. Owing to the high speed, it was absolutely necessary to have a perfect fit in the piston and cylinder.

Salem, N. J. GEORGE WACKER.

Micrometer Attachment for the Lathe.

Editor American Machinist:

This sketch shows what I consider a very handy micrometer attachment to be used in connection with the carriage of the lathe for producing accurate work, as in recessing irregular forms, facing a given amount from a piece of work, or in measuring the distance from one shoulder to another, thus doing away with the cut and try method commonly in use.



MICROMETER ATTACHMENT FOR THE LATHE.

The main block *A* is of cast iron and threaded its entire length, adjustment being provided for by means of saw cuts and two filister head screws *g g*. The screw *B* is 1-10 inch pitch, with V form of thread, the coarse pitch facilitating rapid adjustment. The dial is graduated in 100 equal parts, thus giving for each division 1-100 of 1-10 or 0.001 inch. The reading is made on the index bar, which is graduated in tenths. The clamp *C*,

which is made of machine steel, is let into the main block *A* to prevent it from turning while clamping to the lathe. A slot in this clamp, ⅜x1¾ inches, allows the fixture to be clamped to the lathe without removal of the knurled thumb screw *h*.

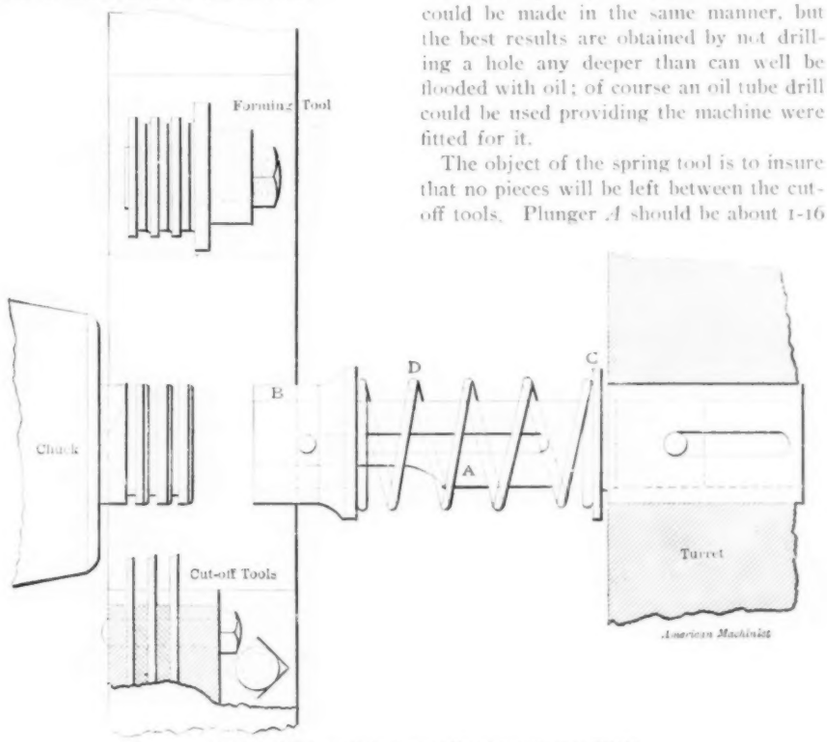
The fixture should be clamped to the right of the carriage so that the measuring screw follows the carriage. Set the tool or take a light cut across the face of the work, and place the measuring screw against the carriage, at the same time turning the screw so as to keep it in contact with the carriage until the right distance or desired depth is obtained.

LATHE HAND.

Making Lock Nuts on the Screw Machine.

Editor American Machinist:

When a quantity of small parts are to be made, the output can be increased and the cost kept low by making two or more parts in one operation. The pieces made with the tools described herewith are turned out three at a time on the screw machine; they are for sprocket lock-nuts and are tapped in another machine. About 150,000 are required each year. The dimensions are as follows: Diameter of stock, 1 43-64 inches; diameter of formed ring, 1 21-32 inches; length, 3-16 inch; diameter of hole, 1 19-64 inches. We have no trouble in making 700 of these lock-nuts in ten hours, on one machine.



MAKING LOCK NUTS IN THE SCREW MACHINE.

The tools are of good carbon steel—I say carbon, as we use air-hardening steel on several jobs. The turret tools used are: stop, 1¼-inch drill, 1 19-64 inch reamer—"four lip"—and spring tool for removing the parts from the cut-off tools. The cams are arranged so that the forming tool and drill work together, and the reamer and cut-off tools work together; the pieces are nearly cut off while the reamer is going in, and the cut-off tools and spring tool then work together. The cut-off tools are brought into operation the second time by what I call double camming.

As the pieces are nearly cut off, the turret comes well forward and plunger *A* enters the hole. Sliding collar *B* comes against the first piece before the feed is thrown in and cut-off tools commence to cut. A portion of plunger *A* is cut away at the outer end so that the tools will not strike it.

The split taper collar *C*, which one end of spring *D* presses against, acts as a retarder so that when the turret advances towards sliding collar *B*, plunger *A* will feed into the hole as rapidly as the turret is brought forward until it strikes the bottom of the hole in the formed pieces; then the plunger slides in the sleeve in the turret.

The cut-off tools complete their work when the turret lacks about one inch of completing its forward travel; then the feed is thrown out, and turret is brought forward rapidly and at the same time the cut-off tools are withdrawn. This leaves the three pieces on plunger *A* from which they are thrown or stripped by the spring and collar *B* as the turret returns.

Four, or perhaps five, pieces like these could be made in the same manner, but the best results are obtained by not drilling a hole any deeper than can well be flooded with oil; of course an oil tube drill could be used providing the machine were fitted for it.

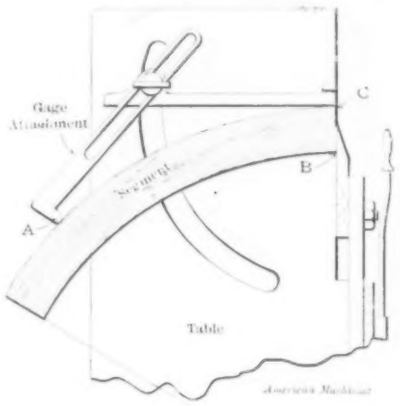
The object of the spring tool is to insure that no pieces will be left between the cut-off tools. Plunger *A* should be about 1-16 inch loose in the hole, so that any burr thrown up by the cut-off tools will not make the rings stick on the plunger and prevent the sliding collar *B* from operating. It is a good plan to groove the face of the collar that comes against the work, for we have found that if the surface is left unbroken, ofttimes the nuts stick to it; as oil, after it has been used for some time, becomes quite thick and has considerable adhesive power. It is advisable not to drill and ream any deeper than necessary, as the last piece, or piece next to the chuck, is apt to stick to the end of the bar if the small burr or ring left from the cut-off tool is forced into the hole, and when the drill comes forward and enters the hole the forming tool is apt to break, as the spring will not rotate so the tools can cut.

LEROY TABOR.

Trimmer Attachment.

Editor American Machinist:

The sketch shows a simple attachment for the wood trimmer; this is very handy in trimming segments, or other pieces to length; it is out of the way for regular work and can be set in an instant for special work as above. The back of the segment rests on the lug *A* when trimming both ends; the lug is used as a stop when gaging straight pieces cut to the same length.



TRIMMER ATTACHMENT.

The adjusting of the gage to cut segments is done in this way: When marking or laying out, the first segment or templet, I make it the exact length, drawing the radial lines for the ends and allowing about ⅛ inch for trimming. The segment is placed on the table with radial line, as shown at *B* and *C*. Before making the cut I adjust the gage, but no attention is given to the length the segments are to be trimmed; I have allowed about ⅛ inch to trim and this I gage with the eye. I have used this gage when trimming segments for a pattern 32 inches deep and 28 inches diameter, the segments being ⅞ inch thick, and never made more than one cut excepting on the sixth or last segment in each course.

JOB SHOP.

An Interesting Staking Job.

Editor American Machinist:

In the factory where I work they have, for some years, made for a machine certain pieces that have given them a good deal of trouble and caused considerable expense. These parts consisted of plates, which were nearly round, with a ¾-inch

rod through the center of each. The plate and rod were cast of steel in one piece, but almost invariably there were blowholes where the rod and plate were connected, making the part frail and unreliable. The rods were turned all over,

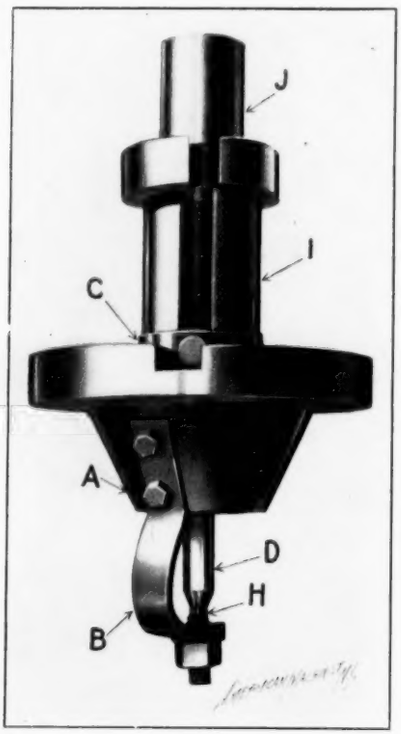


FIG 1. STAKING TOOLS.

and the plates faced down, thus exposing the blowholes, which condemned the piece.

I suggested making the plates in the punch press, and fastening them by staking. This method was tried and found very satisfactory.

A gang-die with two punches—one for piercing the center hole 23-32 inch diameter, and one for blanking the plates—was made of the ordinary type for blanking washers, the plates being 3-16 inch thick soft sheet steel. A ¾-inch reamer was then run through the hole in the plate to straighten and smooth it, as it was tapering from punching, the punch being 1-32 inch smaller than the die.

The rods were made of ¾-inch round cold rolled steel, cut off about 12 inches long; the ends were pointed in a Jones & Lamson lathe, and a recess was cut in the middle 1-32 inch deep, and as wide as the thickness of the plates, or 3-16 inch.

A set of staking dies were then employed for fastening the two pieces together, as shown by Figs. 1 and 2; Fig. 1 showing the die assembled and the work in place, and Fig. 2 showing each piece separately. The large piece *A* at the right, Fig. 2, is the die holder; this is a steel casting which is dropped into the bed plate of the punch press with spring *B* down,

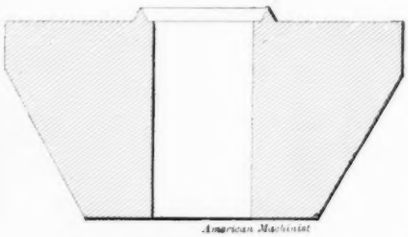


FIG. 3. SECTION OF STAKING DIE.

and held in place with a strap at each side, slot *C*, Fig. 1, facing the operator. This slot is to accommodate a projection on the plate. *D* is the rod with a plate *E* in position. After holder *A* is strapped down the plate *g* is slipped on the rod *f* and placed at the middle—or at the recess already mentioned—and the staking die *F* is slid on the rod and against the under side of the plate.

This die is made of tool steel, hardened, and drawn to a dark straw; the taper part fits in the die-holder, the upper face being straight, except where the staking edge is turned up. Fig. 3 shows the section of this die. The upper staking die *G*, also made of tooled steel, hardened and drawn, is now put on the other end of the rod, the staking edge down toward the plate. Rod, plate and dies are now together dropped in place in the die-holder *A*, when the rod goes through the hole in the bottom and rests against the end of a hardened set screw *H* on spring *B*, which screw locates the rod correctly, relative to plate E. The slotted, round cast iron block *I*, Fig. 2, is now slipped on rod *D*. The cast iron press-block *J* is held in the ram of the press, being up and out of the way when the other pieces are placed in position, and comes down on the top of block *I*, doing the work, when the treadle of the machine is pressed down. The slot in *J* is to make room for the upper end of rod *D* when placed in the press, the stroke of the machine being only 3 inches.

The staking edges force the metal around the hole of the plate into the recess of the rod and fasten the two pieces together very firmly; this is necessary, as they have to resist a great many hard blows while working. So far no trouble has been reported; this method having been in use upward of two years.

J. J. HAGELGREN.

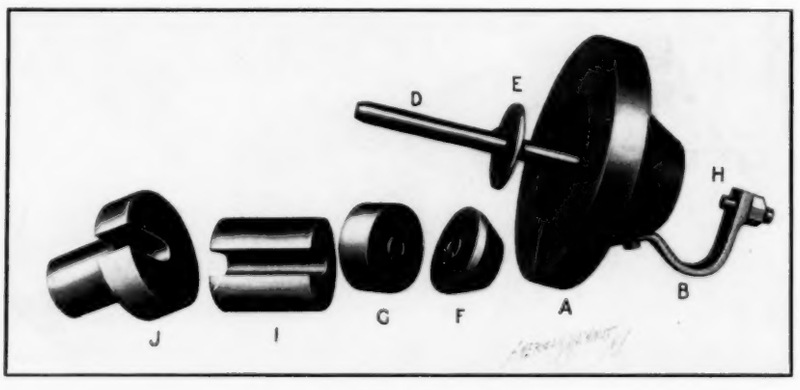


FIG. 2. STAKING TOOLS.

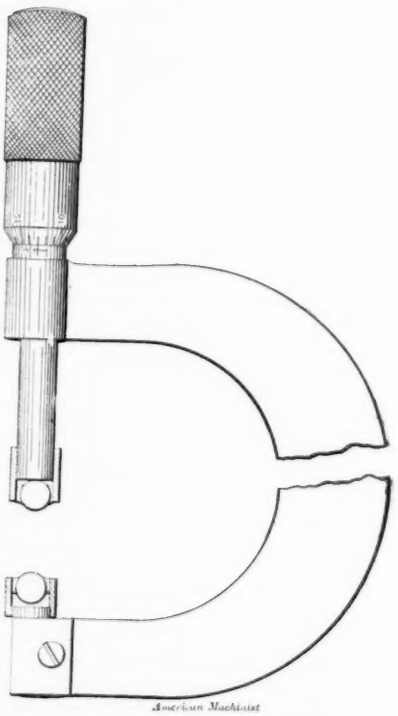
Ball Tips for the Micrometer.

Editor American Machinist:

I herewith send a sketch showing a pair of ball tips, or measuring points, I have made for a micrometer. The two steel balls, each 0.25 inch diameter, are held on the micrometer points with pieces of steel tubing, as shown. I find them especially useful when measuring work having curved surfaces—as in finding the thickness of rings, etc. Another advantage I find in using these balls: there is not the tendency for grit to get lodged between the measuring surfaces, and they give a most satisfactory result. I think this idea will be of use to some of the AMERICAN MACHINIST readers, because these measuring tips can be easily made to fit any size of micrometer.

E. J. TOWNDROW.

Essex, England.



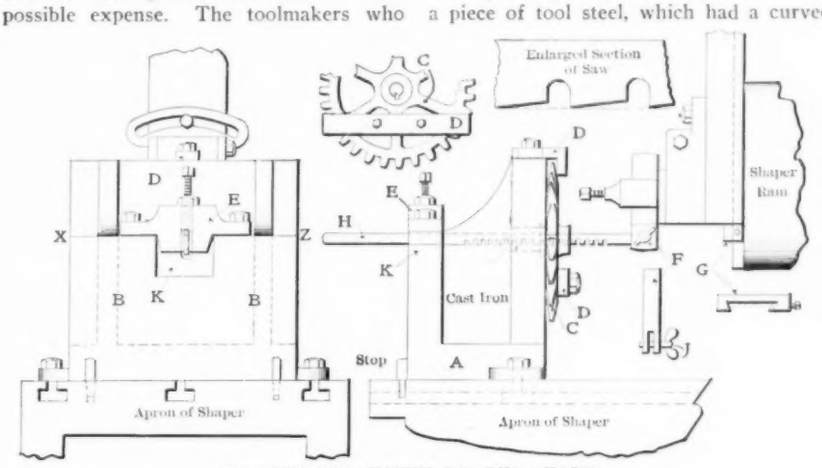
BALL TIPS FOR THE MICROMETER.

A Slotting Attachment for the Shaper.

Editor American Machinist:

In the good old bicycle days many were the queer contraptions concocted to get out the work quickly and with the least possible expense. The toolmakers who designed and built fixtures for machining bicycle parts in those days were no more ingenious than toolmakers now are; still, in raking up experiences of tools built at that time there is one which I remember quite well that might be used by the "latter day saints" to good advantage. It will be borne in mind that every shop is not the fortunate possessor of a "slotter," and in this letter I will try to describe an attachment for a shaper for slotting or splining small work, such as pinions, collars, split bushings and the like. In the illustration *A* is a cast-iron standard bolted to the shaper apron and held in permanent position by two stops placed at the front. The casting is webbed at the dotted lines *B B*. *C* is the sprocket to be keyseated, held in position by clamps *D D*, and, the hub being turned true with the hole, the casting *A* is counterbored just large enough to receive it. (Other work may be held by the clamps and located by a center line drawn across the work and matching that line with another on the working face of casting *A* from *X* to *Z*.) *H* is a special cutter of tool steel. It is taken out after each piece is splined by removing a tapered pin *J* in the holder *F*. *E* is made of machine steel, and its function is to guide and at the same time hold in one position the outer end of the saw. It is fitted with set-screw and jam-nut to take up the vertical motion of *H* and also to aline the cutting edge square with the hole in the work. *K K* are openings in *A* to allow the saw to be taken in or out. *G* is a stop that determines the depth of the cut.

CARROLL ASHLEY.



SLOTTING ATTACHMENT FOR THE SHAPER.

Turning Concave Rolls.

Editor American Machinist:

Having to make a number of tool steel rolls, with faces turned concave to a radius of 16 inches, as shown in Fig. 1, which job, as every lathe hands knows, would be a tedious one to do in the ordinary way in an engine lathe, as the curve had to be just right, we proceeded in the following manner: From a Pratt & Whitney 24-inch lathe we removed the guide of the taper attachment and replaced it with a piece of tool steel, which had a curved slot milled in it, as shown in Fig. 2. The bar of the cross slide was then connected to it, as in Fig. 3. Using this outfit, in the manner indicated in Fig. 4, we got a very uniform and satisfactory set of rolls in a very short time.

In setting the job all there was to do was to see that the point of the tool, the center of the guide and the center of the roll were in line.

FRED. J. KUHLMANN.

Chicago.

[At the shops of the Cincinnati Machine Tool Company where they are doing very high grade work on drill presses they have a device similar in principle to the above for crowning cone and other pulleys, and an English correspondent sends us a contribution describing what is essentially the same thing applied to an English lathe, having no taper attachment, and therefore requiring that a bracket be provided for supporting the curved guide block.—Ed.]

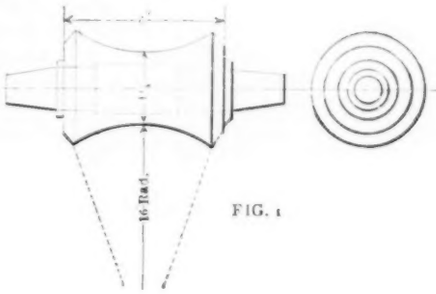


FIG. 1.

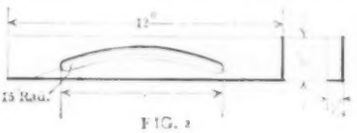


FIG. 2.

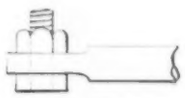


FIG. 3.

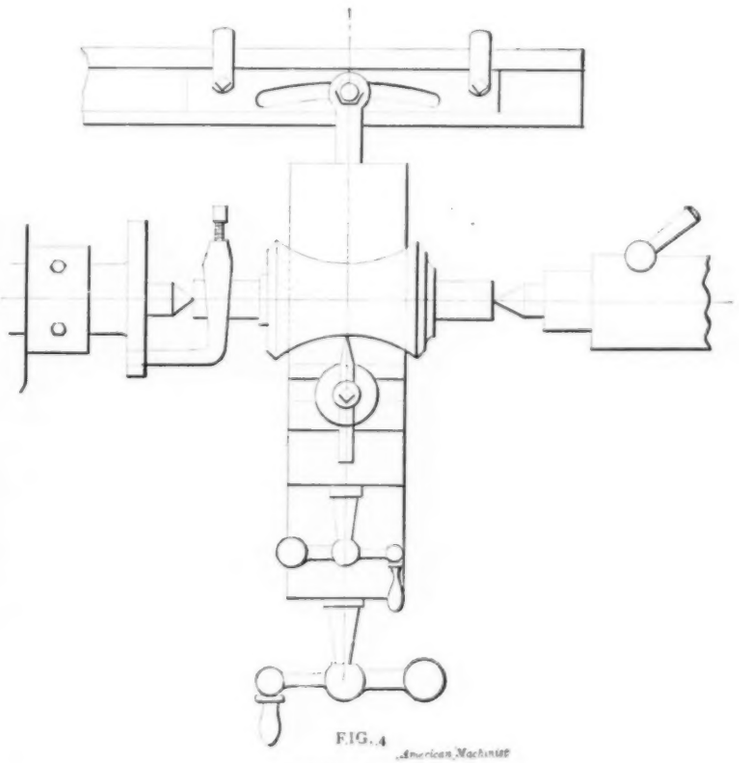


FIG. 4.

American Machinist

TURNING A CONCAVE ROLL.

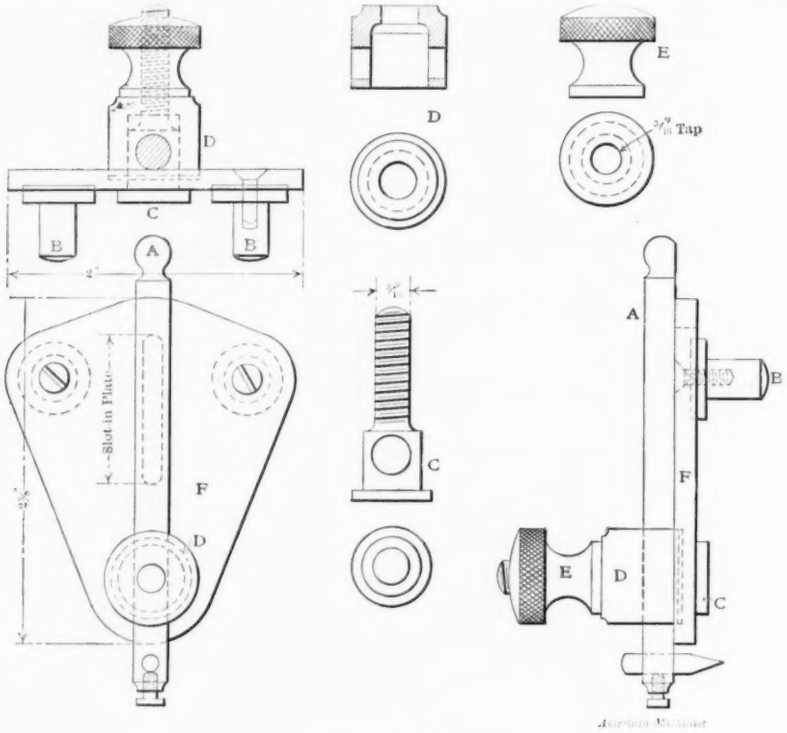
Handy Scriber.

Editor American Machinist:

I enclose a sketch of a useful little scriber which I designed about three years ago. I have found it very handy both for parallel and circular work, particularly for

scribing bolt centers on round and square flanges of valves, pipes, etc.

It will scribe any distance from 1-16 to 3½ inches, and the scribing point may be firmly fixed in any position inside the radius of the scribing rod. By placing the rod parallel with the guide studs, the scriber point is in advance of the body of the tool, which makes it possible to scribe a line to the very edge of a casting, while the studs have a firm guide on the work. For short distances the scriber point may be placed in the slot indicated by dotted lines in frame *F*. When folded up it makes a very neat and compact tool. I may say that I have seen several since made from the above design, so I think a brief description may be of interest to some of my fellow readers.



HANDY SCRIBER.

The scriber rod *A* is made from ¼ inch round tool steel, and a flat is filed on one side to prevent it turning in the hole. A ⅛-inch hole is drilled in one end for the scriber point which is fastened in position by a small screw, as shown. The frame *F* is made from 2x⅛-inch sheet steel, and is drilled and counterbored to receive studs *B B*, which are secured by small screws, as shown; this enables the studs to be hardened and replaced easily. In the opposite end, the frame is drilled to receive stud *C*, and counterbored to suit bush *D*. A hole is then drilled through both stud and bush, to receive scriber *A*, care being taken to drill the hole in such a position as to allow the flat part of scriber rod to work freely upon the top of the frame.

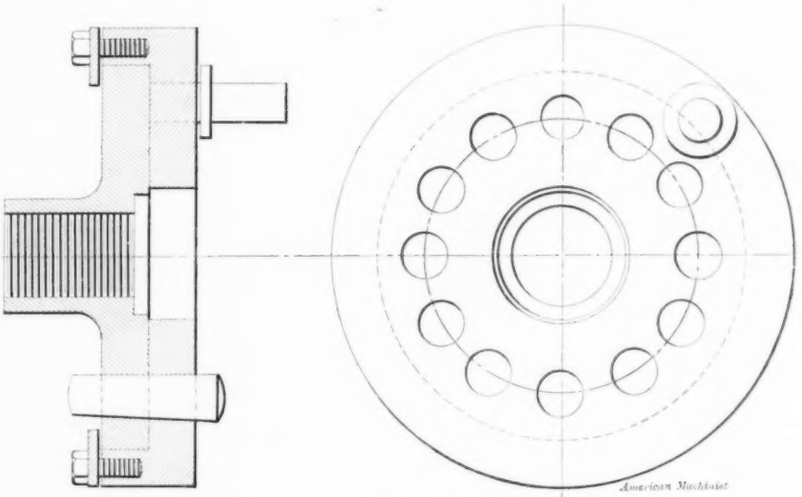
The rod is held firmly in any position by tightening the knurled nut *E* upon bushing *D*, which is made to "clear" the bottom of the counterbore slightly in order to give the necessary "draw" upon the rod. TOOLMAKER.

Face-Plate Fixture for Multiple Thread Cutting.

Editor American Machinist:

I noticed in a recent issue a description of a method of cutting a triple thread by dividing the driving plate and using three studs for driving the carrier. Some years ago I was employed at a works where we had to do a deal of multiple thread work, and I devised a plate which was used on various numbers of leads with success. On an ordinary driving plate we fitted a plate having, as shown in sketch, twelve holes enabling us to get two, three, four or six leads if required. This ring carried the driving stud, and was clamped at the back of the plate by two bolts as an extra safeguard. All that was necessary was to slack the bolts off, withdraw the index pin, move the plate the number of holes required, and re-tighten the bolts. It proved a time saver, and we used it on different lathes, as occasion required, by making the driving plates alike and drilling a hole for the index pin. I found that the index pin worked best when made taper, and a light tap was sufficient to loosen or fix it. The clamping bolts were added on the principle of the Thames bargee, that "it's better to be safe than sorry." T. RIDER.

Plumstead, England.



FACE PLATE FIXTURE FOR MULTIPLE THREAD CUTTING.

Jig Feet.

Editor American Machinist:

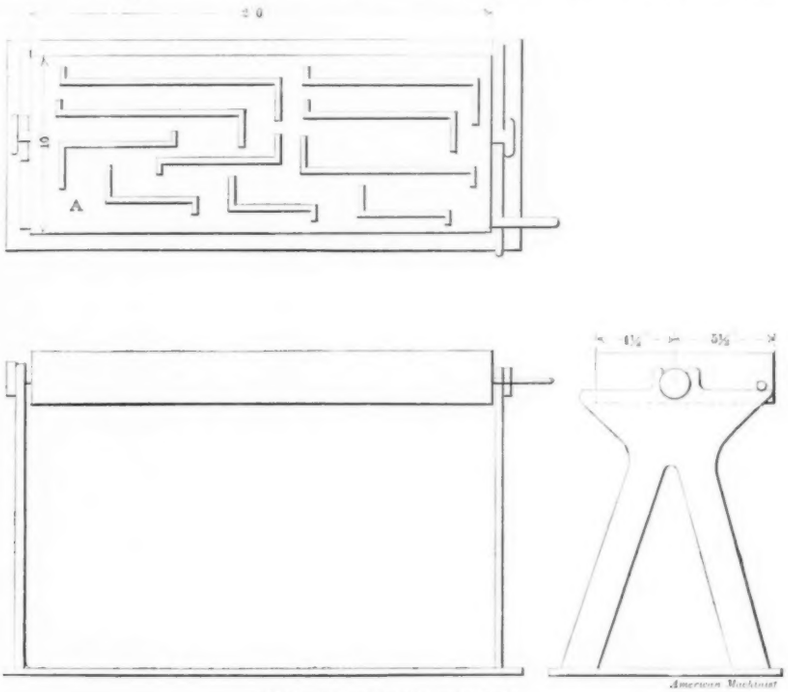
At page 343 I notice that S. Cox takes our friend Danse rather severely to task about a previous article of his on jig design—jig feet in particular. Being in a position to look at the matter from an unbiased standpoint, as I have both kinds to contend with almost every day, I must say that I am strongly in favor of feet for drilling jigs where it is possible to put them on. Now, where a jig is designed for drilling but the one hole, friend Cox is all right; don't use feet but clamp the jig down tight and then sail in and drill. But, suppose a jig has been designed for drilling a large number of holes, will you clamp it down separately for each hole? I think not. Now, here is just where the jig with the feet on shines out. Take a jig for drilling cash-register or typewriter parts where there are twelve or fourteen holes of the same size to be drilled (and it is very often the case) the jig, to be profitable, must be handled as rapidly and accurately as possible; and, to do this, chips and dirt must be kept from underneath the jig and as few clamps and bolts used as possible. Where a jig without feet is used it is necessary to remove it from the machine and clean the bottom of the jig and the drill-press table top—not very pleasant where the jig and work weigh

perhaps 30 or 40 pounds, and not very profitable, either. Now, if the drill jig is furnished with a good set of feet, just move it gently back and forth a few times and you can depend upon it being perfectly free from chips and dirt. The slots and holes in the drill-press table may seem like an argument against jig feet being used, but demand when purchasing a machine of this sort that the table be free from slots and holes and the manufacturer will, as a rule, be pleased to furnish it this way. Friend Cox alludes to the method of fining an operator. That may to some seem feasible, but it is only meeting the difficulty half way; if I had a machine operator who was incompetent or unsatisfactory, I would be looking for one that suited, and find one, too. As for a hexagon, wing or spanner nut on a jig, it certainly requires as much tension to pull up on a cam or an eccentric as it does to tighten a nut, and in its proper place the one is as satisfactory as the other. CY ANIDE.

Cast Iron Gagger Mold.

Editor American Machinist:

The gagger is one of the things which must be always to hand in the foundry and the various sizes should be placed in suitable bins so that no time is lost by the molder in hunting them up. Having had considerable difficulty in obtaining a sufficient supply of these indispensable articles, the smiths being either too busy with other work to make them or, at other times no suitable rod being obtainable at the stores, we were left no other recourse but the cast-iron gagger.



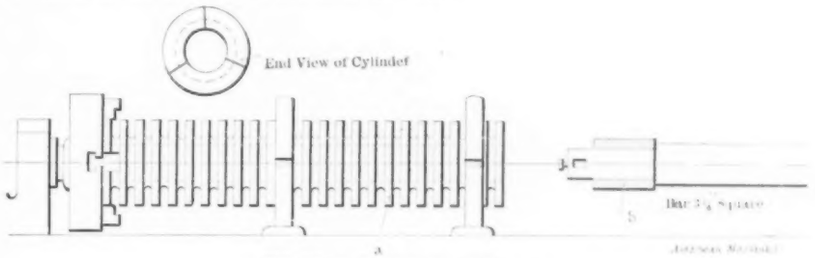
MOLD FOR CASTING GAGGERS.

The sketch shows a device for making gaggers which gives good results. The plate *A* is mounted on trunnions and has gagger molds of suitable sizes recessed on both faces. The trunnions are cast in the plate a little out of balance, so that the plate handle (also cast in the plate) rests on a projection of the trestle. When the molds are poured and allowed to set for a few minutes, the plate is turned over on the trestle by means of the handle and the gaggers drop out on to the floor. The molds are now poured on the top side and the reversing is repeated as often as required. These gaggers are very neat and are no heavier than wrought ones made from ½-inch rod. They are clean and receive no dressing. The molders prefer them, as they can be readily snapped off to suit small pockets and corners in various molds. Before using the mold it is given a coat of blacking and is warmed a little so that the metal will not fly when pouring. G. BUCHANAN.

Boring a Peculiar Cylinder.

Editor American Machinist:

I am sending you a sketch of a job I had to do some time ago, and which I thought might be of interest, as it is a bit out of the run of ordinary boring jobs.



BORING A PECULIAR CYLINDER.

The cylinder *a*, made of gun metal, is 12 feet 6½ inches long, with a 5-inch hole bored through. The casting for it was in three sections, the joints being planed and the pieces tinned together for boring and tapping. I chucked it by one end in a long shafting lathe, ran the body in two steady rests, as shown, and bored the 5-inch hole with a bar held in the slide rest.

I made the bar of a piece of rough 3¼-inch square steel, with the end turned down to 3 inches, and a slot put in to take the boring tools. I then fitted two cast iron bushes *b* to the end, which I had turned down, one bush being 1-32 inch under 5 inches, and the other free to the 5-inch gage. Then I made two boring tools, one slightly larger than the small bush, so as to allow for wear, and the other one to the 5-inch gage to cut on both edges, back and front.

I was now ready for work, and skimmed out the end of the cylinder to 4 31-32 inches free, to suit the small bush, then put the long bar in the rest, put the small bush and tool in place and pushed the bush into the hole I had just bored; the cut was then started, and ran through without any trouble. I then finished it by opening out the hole to 5 inches at the end, changing bushes and tools and running the finishing cut through. The result was very gratifying; it was a good, quick job. J. WHEELER.

London, England.

Half-inch Lard Oil.

Editor American Machinist:

Some lard oil experiments I had made a year ago may perhaps be of interest. Matt had ordered a barrel of lard oil for me, which was kept outside while awaiting the completion of the oil-house. This oil-house was an elaborate affair, and as it happened to be built some distance from Manchester, the limit of 2,200 bricks a day was never approached nearer than three figures, consequently the oil was occasionally up against some rather cold weather. It was on one of these cold days that Matt sent back word by the boy that the "bloody oil" wouldn't run, and he couldn't get any for me. I had to have that oil, and the number of crazy schemes that were evolved inside of twenty seconds would fill three columns, but wouldn't do the job, so I decided to interview Matt. "It's up to you, Mr. Forner," said Matt—he also is an American—"the sanguinary stuff is frozen and I can't get any unless I knock the head in." Now, it happened that I had been talking with the head push a few minutes before, and as

he was a big blow, my thoughts naturally turned to pneumatics. I inquired of Matt if he had a bicycle pump. Matt was quick to catch the idea, and in a few minutes we had a ¼-inch hole in the bung, the pump screwed in and a coil of the finest ½-inch lard oil you ever saw issuing from the faucet and coiling in the bottom of the pail as neatly as Jacktar coils a halyard. Matt sent in a bill for 117 feet of ½-inch hard oil, and I slept that night the same as usual. Ideas like that never seem to disturb me.

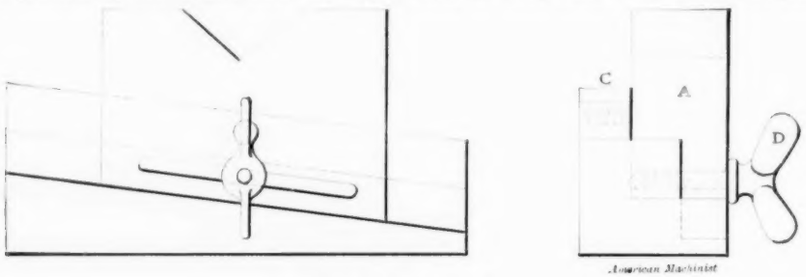
ADAM FORNER.

England.

Adjustable V-Block.

Editor American Machinist:

I enclose sketch of an adjustable V-block, which a friend tells me he has found very handy. The sliding part *A* can be in the position shown or shifted to the top ledge *c*, according to the hight required. Intermediate hights can be obtained by adjusting the sliding part, which is held in position by the thumb-screw *D*. The idea, I think, will be clear enough from the sketch, without further description.



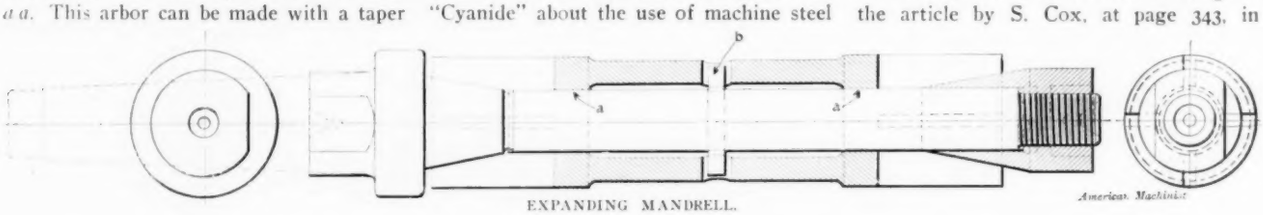
ADJUSTABLE V-BLOCK.

CHERRY RED.

Expanding Mandrel.

Editor American Machinist:

The sketch shows an expanding mandrel, which will be found useful where it is required to do good work on the lathe with forming cutters. It consists of an arbor and an expanding shell, the latter being tapered at both ends to suit the arbor and nut. Bearings are left also at *a a*. This arbor can be made with a taper shank, or to be driven by a dog. Pin *b* prevents the sleeve from coming off with the work.



EXPANDING MANDRELL.

C. W. PUTNAM.

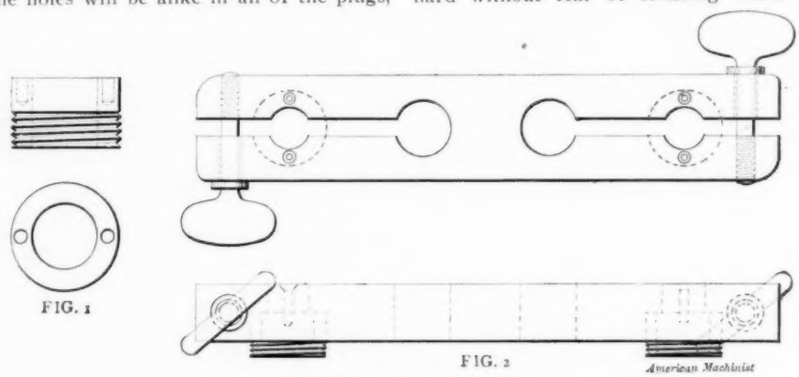
Holyoke, Mass.

A Simple Jig for Drilling Pin Wrench Holes in Threaded Plugs.

Editor American Machinist:

It being "up to me" to design a set of jigs for drilling holes in various sizes of screw plugs (like Fig. 1), which were used as spring retainers, I devised the style shown in Fig. 2, which were made of mild steel and case hardened.

Upon trial these jigs proved very satisfactory. It is obvious that the location of the holes will be alike in all of the plugs, owing to the fact that these are made from cold rolled bar stock, whose diameter, as is well known, seldom varies more than 0.002 or 0.003 inch, which could not possibly do any harm on this class of work, as the pins in the spanner wrench were made somewhat smaller than the holes. The jig is made double ended simply to facilitate the drilling operation.



A SIMPLE DRILL JIG.

ROBT. A. LACHMANN.

Jig Design.

Editor American Machinist:

I have been interested in the various articles on jig construction, particularly the ones written by Mr. Arthur and Mr. Danse. I do not, however, agree with "Cyanide" about the use of machine steel for bushings. I believe that a great many firms that are now using tool steel for their bushings, locating pins, stops and other small parts of their jigs, would find quite a saving at the end of the year by using machine steel.

When we consider the fact that the cost of material is 4 to 1 in favor of the machine steel, the cost of machining 3 to 1 in its favor, and the loss from breakage in hardening practically nothing, the fact is evident that the machine steel is the best from the manufacturer's standpoint. In the item of wear on the bush, I believe that the argument is in favor of the machine steel, as it may be left excessively hard without fear of breaking while in use; and taking it all in all, the machine steel will give the best result in the end.

There seems to be a great diversity of opinion on the practicability of jigs with feet, of which I was not aware up to a short time ago, as I have always been of the opinion that feet were a necessity where the jig *was not fastened down*. I am still of that opinion (although I have seen very good work done in jigs without feet), and believe that more and better work can be done with jigs having feet, as the operator is not bothered with chips under the jig, and the consequent poor work and the breaking of drills; for if the feet are not too large a slight movement of the jig serves to level it.

The main object in building jigs and fixtures is to obtain accurate work and plenty of it, and I believe that the designer that leaves an opportunity for an operative to do poor work, or to have an excuse for a small amount of work, is not fulfilling his mission in life. I have found that if it is possible for an operative to get work wrong he will do it, as the majority of persons employed on this class of work are far from being skilled mechanics.

I cannot close without commenting on the article by S. Cox, at page 343, in which Mr. Cox criticises Mr. Danse's methods. Mr. Cox claims that some operatives will drill all around a bushing if the jig is not fastened down, and also that jigs with feet are consequently an abomination, as they are not easily fastened down. He is quite right in the main, but very few designers would build a jig with feet that *could be fastened down*. The fact remains that in the majority of work done in jigs there are two or more holes, and very often more than one side of the

jig is being used, consequently the feet are a necessity. A case-hardened plate around the bushing will prevent the operator from drilling into the jig body; but a discharge and the employment of competent help is the best remedy.

I agree with Mr. Cox in regard to dispensing with nuts, bolts, etc., if possible, for with a quick-acting fastening device twice the amount of work may be done, and the life of the jig often exceeds that of the one where a wrench has to be used.

W. W. PATTERSON.

Detroit, Mich.

Editor American Machinist:

Mr. S. Cox, of Redditch, England, at page 343, takes exception to my belief that jigs should have feet. Although he states that he has a variety of reasons for differing with me, he mentions only a single one, namely, that feet are usually put only on little jigs handled by careless operators who will do better work if the jig is clamped down so that they can't miss the hole.

If Mr. Cox ever comes over here, I can put him in the way of seeing a jig weighing about 200 pounds with feet on it. This jig was designed by myself for drilling fifty-two holes in the angle iron frame of an automobile, and is sufficient to dispose of the contention that feet are never put on large jigs. This jig would please Mr. Cox, too, as it is designed to be bolted down as a fixture on the platen of an eight-spindle drill. The work comes to it in lots of 100 to 200 pieces, and the fifty-two holes are drilled in seven operations.

Now as to this matter of bolting down jigs. There is no question of the advantage to be gained by doing so when the conditions are favorable; but, unfortunately, they are rarely so. Usually a number of holes must be drilled in the work and the more of them one can drill at one setting the less time will be lost in settings. A multi-spindle drill is a great help in accomplishing the maximum saving in this respect. When the holes are far enough apart to admit of drilling several at once, we get the best results. When this cannot be accomplished, we can use different sizes of drills in different spindles and drill the holes of corresponding sizes successively, moving the jig from spindle to spindle. This usually precludes the possibility of clamping down the jig, particularly as the holes frequently come in various sides of the work.

One of my jigs which would doubtless please my critic is for drilling forty-five rivet holes in an automobile brake band. These holes are in nine groups of five holes each and fall in three rows, one row in the center of the width and the other two rows about ⅛ inch on each side of the center. The jig consists of a base, planed out to receive a long slide. This slide receives the work and carries the bushing plate and work clamps, and also a spring plunger which enables the operator to locate the bushings directly under the four drills of the multi-spindle sensitive. Two cams, connected with the holding down clamps of the jig enable the operator to instantly move the whole jig forward or back to change from one row of holes to another with the most positive accuracy. This is a case in which I combined the advantages of a fixture with those of a movable jig. One feature of both the jigs mentioned is that they are so constructed as to clear themselves of chips, it being practically impossible for a chip to lodge where it can affect the accuracy of the work.

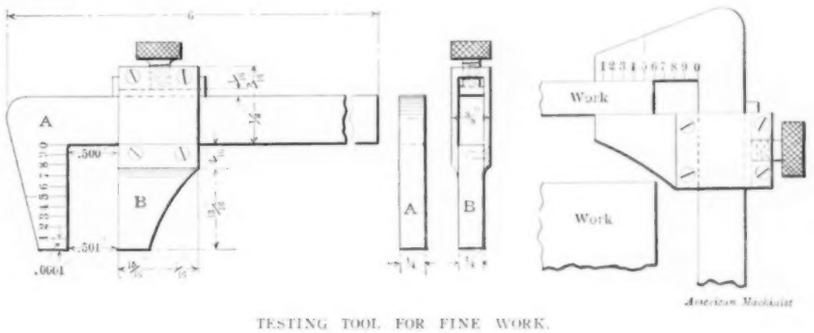
It is not always necessary and often not even desirable to use a multiple spindle drill on jig work, as slip sockets frequently answer as well or better, and permit changing drills or substituting chucking reamers or taps without stopping the spindle. I am astonished to see how little the slip socket is appreciated, even in many otherwise thoroughly equipped shops. I have in mind in this connection one of the best equipped shops in the country wherein I saw numerous operations which could have been better done at one setting, being done in a number of settings simply because the shop had no slip sockets.

Detroit, Mich. L. O. DANSE.

A Testing Tool for Fine Work.

Editor American Machinist:

The enclosed sketches show a very fine tool for testing work to 0.0001 inch and less; you can measure much closer with this than with micrometers. The jaws are 1 inch long, are .001 inch farther apart at the point than at the back, and the fixed jaw is graduated in tenths on one side, thus variations of 0.001 inch or less may be detected in work placed between the jaws. Say we have a piece to test, like the one shown in the sketch, to see if its faces are perfectly parallel; move the jaws down on the work, say, at 4, 5 or 6, and try all four corners and see if they come to the same point. If they do, the piece is exact.



TESTING TOOL FOR FINE WORK.

If not, whatever it is out is plainly shown by the graduations. Anyone with fine work to do will appreciate this tool. I had a lot of pieces to grind that had to be exact. I thought I could grind them close enough with my micrometers, but I could not, so I made one of these tools and it worked fine; you will be surprised to see how closely you can measure with it. This tool must be hardened and ground all over.

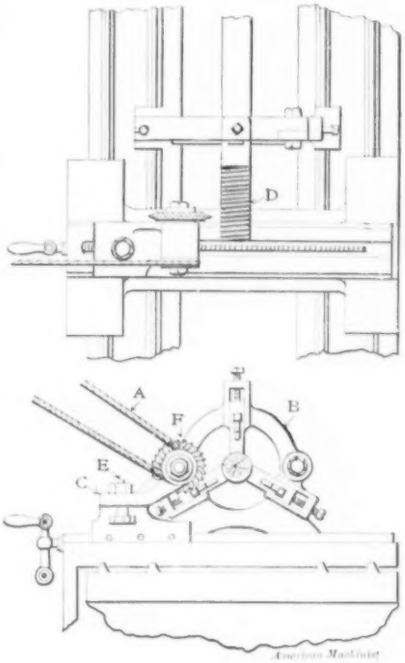
Washington, D. C. C. W. TUCKER.

Cutting Threads on Wood.

Editor American Machinist:

The task of cutting standard machine threads on wooden rods is an arduous one, if we try to do it with an ordinary lathe thread cutting tool.

Our work required a great quantity of



CUTTING SCREW THREADS ON WOOD.

such rods, their sizes ranging from 1 inch to 2½ inches in diameter, and from 3 to 6 feet long, with 4 inches of thread on each end. The sketch will show how we satisfactorily do the work.

Belt *A* is round, ½ inch in diameter, and runs over a pulley on the line shaft and over the small pulley on the cutter shaft. The frame *C*, of cast iron, is bolted to the tool-post block. The cutter *F* is made like a milling cutter, having the teeth shaped to give the proper angle to the threads.

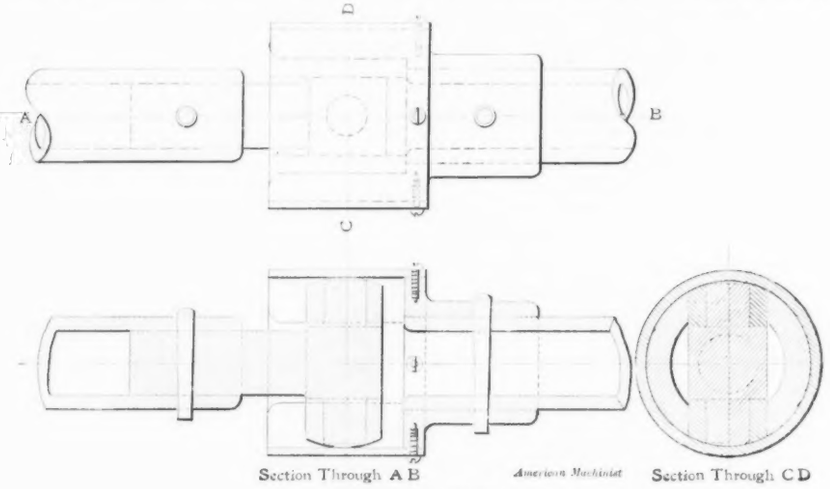
To obtain the pitch angle on the thread, a few pieces of thin sheet iron are placed under one side of *C*, the number of shims being determined by the pitch of the thread. The grooved pulley on the line

shaft is placed about midway of the lathe bed, the straight-line distance of the lathe from the shaft is about 20 feet. This arrangement allows the carriage a movement of nearly the entire length of the machine, without materially affecting the efficiency of the drive. JOS. N. GERMAIN.

Universal Joint.

Editor American Machinist:

The accompanying drawing illustrates and explains a very practical universal



UNIVERSAL JOINT.

joint that is proving to be quite a success. The crosshead arms and the blocks are machined spherically. The blocks and slide are hardened and ground. N.

Handy Tool for Holding Work in the Planer or Milling Vise.

Editor American Machinist:

The sketches show a pinch-finger made by a Swede who is employed in the shop where I am working at present, and who is, in the way of making tools of his own design, one of the cleverest men I have met. This tool is neater and better than anything for a similar purpose I have seen. Fig. 1 shows the front and side views, and Fig. 2 shows the way it natu-

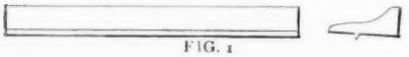


FIG. 1

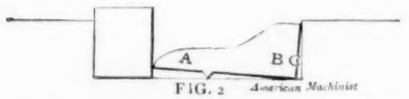


FIG. 2

FOR HOLDING WORK IN THE PLANER OR MILLER VISE.

rally rests in the vise. The small v is made on one side of the center. This makes *B* heavier than *A*. *C* is planed at a slight angle. As the side of the vise presses against the side *C* it gradually straightens up and draws down at *A*; and when the vise is tight *A* has pinched the work down solid. This form of tool will be found very valuable for vise work on the shaper and milling machine.

So. Boston, Mass. PATRICK J. KING.

Lettering Patterns.

Editor American Machinist:

Patternmakers are often required to do this kind of work, and if lacking in experience they find the task rather a difficult one. To help such, a few hints may not come amiss.

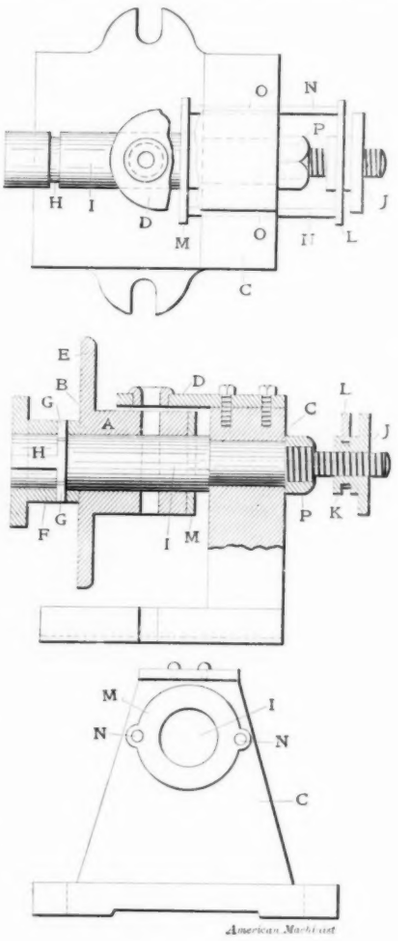
1. If available, a flat surface is always preferable. The letters being themselves straight, can be more easily laid and arranged upon such a surface. For curved surfaces the letters must be bent to conform, and skill and care are required to arrange them. By one or two light taps with the point of a hammer upon the underside of a letter, it can readily be made to fit any curve and to lie as snugly as upon a plain surface. It should be borne in mind that the lettering should be done on the underside of a pattern. A better impression can be made in the sand and the molten metal fills it more perfectly. The vigorous rapping often needed to loosen the cope also would be very apt to mar or break the letter molds.

2. How shall the letters be fastened onto the pattern? If they are of good size, the problem is an easy one and need give no trouble. By drilling small holes in the letters they can be nailed firmly. For this purpose common wire nails, with the heads clipped off, can be used to advantage. The real difficulty in fastening, however, comes when small letters are used. Nails are not available and some kind of cement must be used. The best and most easily applied is shellac varnish. It is certainly preferable to glue, making in the end a far neater job and possessing adhesive qualities equally great. Of course, shellac used for this purpose needs to be of a little thicker consistency than usual. First, it should be spread and allowed to dry on the under or back side of the letters. Then, a little at a time, it can be spread upon that part of the pattern where the letters are to be fixed. The latter can then be taken, one by one, and pressed into the shellac while still soft. After being allowed to stand for a while, the varnish becomes dry and hard, and it will be found that the letters thus imbedded are as firmly cemented to the wood as if fastened with strong glue. They are there to stay, and I have seen patterns after years of use on which lettering thus done still remained intact. HOMO.

A Drilling Jig.

Editor American Machinist:

The sketches show a jig, for drilling the casting *A*, which is a sleeve with a large flange. The hole must be drilled a certain accurate distance from the end *B*, and if the jig was made in the ordinary way, gaging from the upright *C*, the bushing plate *D* would have to be raised above the flange *E*, which would give too much



A DRILL JIG.

room between the bushing and the work, and the drill would run out. The collar *F* is provided with two pins *G G*, which fit the slots *H* in the stud *I*, and by giving the collar a quarter turn it is prevented from slipping off. The slots are made by turning a groove in the stud with a parting tool and then milling or chipping

grooves from the end of the stud to this groove.

The casting is slipped on to the stud, and the collar F is then put on and given a quarter turn, and then the casting is forced up against it by the hand nut *J* on the back end of the stud. This nut has a groove *K* into which fits a yoke *L*, which is connected with the collar *M* by the rods *N N* which run through the upright member of the jig at *O*. The stud is held in the jig casting by the nut *P*.

Hopkins, Minn. J. P. APPLEBY.

Why Be Good?

The announcement to the effect that the inmates of a county jail are to be provided with facilities for physical culture brings the reader again to that paradox of modern civilization by which a young man of exemplary character gets fewer advantages and opportunities than the young man who perseveres in a disregard for law.

Take two boys in an urban tenement district as illustrations. One boy is good. He attends school regularly. He is in a room in which there are twice as many boys as there ought to be and in which the courses of instruction may have practically nothing to do with the industrial life to which he is destined. After a few years of perfunctory study he reaches his industrial majority—14—and he begins to work. He has learned no trade. His "general culture" is not exactly efflorescent. His chances of becoming anything better than an unskilled employee are slight.

How much better would it have been for him if he had been bad! First, he would have been sent to a school for truants. There he would have got much better food than at home, and, in general, much better physical conditions. Also, he would have had instruction much more adapted to his wants, because he would have been given a large amount of manual training.

After he was released from the school for truants, if he only had sense enough to keep on being bad, he would escape going to work and he would be sentenced to a school of delinquents where his education would be continued. More games! More discipline! More manual training! All supervised by experts in the sciences of pedagogy and criminology.

Having become too old for the school for delinquents, our boy now proceeds to a reformatory. The good boy, whom we took leave of some time ago, is expiating his piety in a printing establishment in which he is trying to develop his faculties by means of shoving several thousand pamphlets a day through the throat of a stapler. Our bad boy, shrewdly sticking to his reformatory, gets lots of physical exercise, plenty of reading in the library, and a final fitting for his trade in the elaborately fitted reformatory tool shop. He steps out into the world at the age of twenty a trained American workman, uninjured by excessive toil as a boy, and prepared to use his skill in some trade in which skill means large wages.

Viciousness brings its own reward.—*Chicago Tribune.*

The Court of Appeals, of New York, has declared unconstitutional the eight-hour provision of the Penal Code, which was designed to compel contractors on State work to employ men on such work only eight hours per day. By this decision of the court the law, or at least that part of it, is annulled and contractors on such work will be allowed to make any arrangements they may find practicable. A similar decision has recently been handed down by the Indiana courts, and it seems to be pretty well settled that a municipal or State government at least cannot require that a contractor shall limit the number of hours per day to be worked by his men by any law that can be passed to that effect. Whether this would also be true of a law attempted to be passed through Congress limiting the number of hours per day to be worked by men employed by contractors with the United States Government is a problem, but it has been claimed that that law would also be unconstitutional if passed, and the decisions of the courts so far given seem to indicate that this is really the fact.

Secretary Easley, of the National Civic Federation, announces that there will be held soon in Chicago, an Industrial Conference at which it is expected to have all the principal problems now affecting capital and labor discussed by those men directly concerned in their settlement. Men representing employers, labor organizations and the general public will be invited to participate, and among the plans to be considered is one that manufacturers in a given line of goods shall be induced to agree where the demand of labor is sufficiently insistent, to a gradual reduction of working hours of half an hour per day each year instead of one or more hours at a time, it being hoped that by a general agreement in a given line of trade and by adopting this gradual reduction of time no serious disturbance of business arrangements will take place; part of the plan being to require the labor unions to agree not to restrict production.

It is announced that the Chicago Federation of Labor has taken action, which it is hoped will put a check to what are known as "mushroom strikes," which we presume means strikes believed by the more conservative members of labor organizations to be ill-advised or unjust. The scheme requires that all affiliated local labor organizations submit their troubles to a board for adjustment, and it is expected that this will insure that each case will be at least investigated and negotiations looking to a peaceful settlement carried on before a strike can be declared, or supported by the general labor organization. It is stated in connection with this that the strikes at the Deering & McCormick plants were ill-advised, and would not have taken place had the circumstances been carefully considered.

The Court of Appeals, of New York, in a case concerning what is known as the United States Aluminum Printing Plate Company, has decided that the value of patents may be taken into account in assessing the value of the stock of an incorporated company. Though it had been pointed out that this is in effect a taxing of the patents themselves, nevertheless the decision seems to be based upon the ground that patents or any other things which belong to stockholders and which therefore affect, one way or another, the value of the shares of stock of an incorporated company may be taken into account in assessing the value of such stock for taxing purposes.

The American Metrological Society held its annual meeting in Washington April 25, and the present status of the metric question and the proposed legislation upon it were discussed, but nothing of special importance was done. It was announced, however, that it is the intention when the Shafroth bill looking to the adoption of the metric system by the departments of the Government for their own work is re-introduced in Congress that it will probably be modified so as to leave no excuse for the erroneous impression that it is intended to attempt by this bill to make the metric system the only legal standard.

A recent number of *Dun's Review* contains an article upon the cost of living in the United States, the figures of which article are based upon careful investigation of the ruling prices of those things which are considered to be the ordinary necessaries of life in this country. The figures cover the period from 1860 to date and represent the cost to an individual for the necessaries of life included in the list, range from $312.73 in 1864, to $72.45 in July, 1897, since which time there has been an increase, the figures for the present time being about $101.07.

A recent meeting of what is known as the Can Trust, held in Jersey City, seems to have been rather a stormy one and charges of mismanagement were freely made. Protests by the minority were entered against the small dividends paid, especially in view of the increased business done. Among other facts brought out was that the Trust is making preparations to close up five more of its can factories and that of the three machine shops maintained by it, one and perhaps two will be closed.

It is announced by cable through London, that by a recent arrangement all ships provided for in the increased naval program for Japan, are to be built in England.

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Motor Driven Planers.

In the *American Engineer and Railroad Journal* for May we note an account of a test of a 60-inch by 18-foot planer and some editorial comments upon the same which we in turn venture to comment upon.

The observations made during the test showed the following results:

Power required to reverse from cut to return = 40.2 H.-P.

Average power required during return stroke = 22 H.-P.

Power required at reverse from return to cut = 26.8 H.-P.

Average power required during cutting stroke = 5 H.-P.

While the article does not, in so many words, directly attribute this phenomenon to the reversals of the platen itself, it does fail to point out its real cause, which lies in the reversals of the pulleys and not the platen. This action, which is quite contrary to preconceived ideas, was fully explained in our columns several years ago and, it is fair to assume, would have been referred to by our contemporary had it been understood. A correct understanding of the action was, we believe, first arrived at by William Sellers & Co., and the high speed quick return planer of that house was the direct outcome. Learning that the effort at reversal was chiefly due to the pulleys, and not to the platen, it followed at once that were the machine so designed as to permit the pulleys to run continuously in the same direction, as is the case in the machine referred to, the return speed could be greatly increased without increasing this effort, and, indeed, as repeated tests have shown, with a marked decrease.

The article speaks of the motor as of the constant speed type, in which case it was not suited to its purpose. Motors for this purpose, as was pointed out in our columns long ago, should be wound with an over compound field—part shunt and part series—the effect being to increase the magnetization of the fields at the moment of reversal, and thus get the required increase of torque partly through increased current through the armature and partly through the strengthened fields. The effect of this is to prevent so great an increase in the current strength, protect the armature from so great an overload, and, at the same time, to slightly reduce the speed during the reversal.

Our contemporary also considers it strange that anyone should question the advisability of a flywheel when applied to a planer driving motor. We believe it is the consensus of opinion that a flywheel is beneficial, though by no means to the extent that those who pin their faith upon it believe, and never to an extent that will offset the absence of a compound field. The flywheel will no doubt reduce the surge of current, but in doing this it prolongs the time during which the increased current must act, and thus, while it reduces the effort, it does not reduce the work of the reversal. There is probably some relation between the proper weight of flywheel and the amount of over-compounding of the motor, but we are not aware that it has ever been worked out.

The Engineers' House.

The desirability of a spacious and perfectly equipped house, if not also a magnificent one, in the metropolis of the nation for the joint use of the several national engineering societies has been generally if not universally conceded, and the AMERICAN MACHINIST has constantly advocated it. The convenience and economy of such a house being conceded and the thought of it dwelling constantly in the active minds of the engineering profession, it could not be a dormant idea; it was inevitable that it should grow and that it should stimulate to action. We are happy to note that good work has been done and that most encouraging progress has been made in the promotion of the scheme, but it may be somewhat to be regretted that the enterprise of the daily press has brought the operations to light perhaps somewhat prematurely. As is well known, the Engineer's Club of this city are moving toward the building of a new club house, having secured a plot of ground, perhaps the most desirable and best adapted to their needs to be found in the city, and are planning a suitable building to be erected upon it. The permanent home of the Engineers' Club being thus in sight it naturally suggested the locating of the national engineer's house in the immediate neighborhood as a matter of convenience to the many who would be the users and habitues of both. A very natural and proper thing therefore was done. An option was secured upon property adjoining that of the club, the one facing Bryant Park on Fortieth street, and the other fronting on Thirty-ninth street. The more important thing then done in connection with the provisional securing of a location was the securing also of assurance of adequate financial backing. Mr. John C. Kafer, President of the Engineers' Club, and Mr. John Fritz, the venerable ex-President of the American Society of Mechanical Engineers, saw Mr. Carnegie, and received from him a ready promise to give or advance a million dollars or more that might be needed for the enterprise. As we have said before, we have never had any doubt about the securing of all the money needed when it was needed. Mr. Carnegie could not contribute money more fittingly than to the engineering profession to whose services he was throughout his business career more largely indebted for his success than to any other, and the engineers could more properly receive from him than from any other man, the means for their permanent establishment. No time has been lost in the development of the national engineers' house. It might almost be said that the

slower the movement the better will be the result, as all our ideas are continually enlarging. We need now a thorough planning of the entire enterprise, much more than we need the money. The first thing to be done, the securing of the formal commitment of the various societies to the enterprise, and the organizing of the means for their co-operation, has not yet been done. After that the planning of the building cannot be too carefully considered or too thoroughly discussed. No small ideas should have any chance. If there is a man on earth who can guarantee in advance the acoustics of a place of public meeting, his services should be secured at whatever cost. The planning in detail of the apartments for the exclusive use of each society, so that all may be satisfied, will be one of no small difficulty. Upon the whole the engineers have a great task upon their hands, and it should be as successful as American engineering work already is in its other fields of occupation. In this day of successful combinations it will be a disgrace to American engineers if they for any reason fail to put this project through.

Col. Albert A. Pope, who undoubtedly did more than any other one man to popularize the bicycle in America, is, it is understood to be again at the head of the business, the capital stock of the Pope Manufacturing Company having been increased for the purpose of enabling it to take over the bicycle trust which has for some time been in the hands of a receiver, and the failure of whose business Col. Pope attributes to the fact that the trust managers thought that one of the economies they could inaugurate was to cut off practically all advertising expenses. Col. Pope thinks, on the contrary, that advertising in some form and probably in a variety of forms is necessary for the business; in other words, that its effect is or can be not merely to divert trade from a manufacturer who does not advertise to one who does, but to create trade, to arouse and maintain interest in the wheel, and to make business for builders, which business would not exist at all without some such stimulus.

The Railway Age calls attention to the difference in practice between the East and the West in the style of molds for steel castings, asserting that dry sand is generally used east of Pittsburgh and green sand farther west. Dry sand has been considered necessary to secure clean castings and avoid blow-holes, but it has the great disadvantage of resisting the contraction of the metal in cooling. As this contraction in the case of a locomotive frame amounts to 9 inches, the objection is sufficiently evident. It is claimed that in the West sound steel castings are produced in green sand with the shrinkage trouble mostly eliminated.

Echoes From the Oil Country.

GIVING A BOY A CHANCE TO LEARN TO THINK.

The boy had gone into the shop for the purpose of "learning the machinist's trade." Just what this learning was to consist of he did not know, but he felt that he would be losing something if he did not get all that there was of it. Everybody said that a job shop was the very best kind of a shop to learn in, and that the poorer the tools and the greater the range of the work, and the more unsuited to the tools and the shop it was, the better. As "what everybody says must be true," therefore this particular shop was in the front rank as a place to learn the trade, and the boy was highly favored in having the good fortune to get a place in it.

The boy had learned several things already, and one of them was that when he was told to do a thing he was to do it. There was no use of his excusing himself, he must try and keep on trying until someone would take pity on him and give him a pointer. That was not very pleasant either, sometimes, because you see the thing often looked so exasperatingly easy as soon as he saw how to do it that it made him feel cheap to think that he had not thought of it without any telling.

Such a training soon got him into the habit of trying to think of *some way* of doing every job that he was set at. It was this habit that got him into trouble with the little steam pump.

"Here, Johnnie," all boys are "Johnnie" in some shops, "you go and stick that little steam pump together and take it over by the boiler there, and get it ready for testing. The cylinders and the bed are there, I have the heads and rings here, and you will find the valves and the rest of the small stuff over by the little lathe where Tom is working."

The lad gathered the material all together and began his first job of pump erecting. His very scant knowledge had all been gained by what he had seen during his short time there, but he managed to fasten the cylinders to the ends of the bed. That they were both very loose did not mean anything to him, at least not just then. It took some trying to find which bolts fitted which holes. It was a little bit awkward to spring the end of the piston rod over with one hand while the other one pounded the head in with a block, and he wondered how he would have managed it if the pump had been a couple of sizes larger.

It did seem as though that cylinder was smaller at the bed end, for it took some hard driving to get the head in far enough to be able to get the nut on that held the water end head on. It was easy to slip the valves into place, and not much trouble to drag the pump over by the boiler and get it up on a couple of blocks and get a steam line connected to it. Then the boss was called.

He came over and turned on the steam and promptly blew the packing out of the gland. After putting in some more the steam was again turned on. Nothing moved. The lever on the side of the steam chest was jerked back and forth. Nothing moved. The steam chest was tapped with a hammer first on one end and then on the other. Nothing moved. Finally the lever was jerked rapidly back and forth, while the ends of the steam chest were pounded, and still nothing moved.

"What in the name of common sense have you done to the pump anyhow, you blundering jackass? Bring a monkey wrench 'till I tear it apart and see what *is* the matter. I guess I'd have been ahead if I had put it together myself in the first place." An examination showed that he was an extremely good guesser.

He looked at the valves first and as they were all right he took off a cylinder head and tried to shove the piston head to the other end of its stroke and found that it would not move. A further examination showed that the centers of the cylinders and of the bed did not line with each other, and that the boy had used so much force in driving the head in that he had bent the piston rod quite badly. By the time the man had finished expressing his opinion, and had got the rod out and straightened and properly in place, and the men had had their joke about it, the idea got pretty well through the boy's head that it was a mighty good plan to do a little thinking while he was doing as he was told.

While he had been told what to do he had not been told that he was to do it in any particular way, and—well, there are several ways of doing almost anything, and the poor ways are just as easy to think of as the good ones are; besides that, the *very best* way hasn't been discovered yet.

It was some time after this when the "devil" from the printing office approached the boss with, "They want you down there in the press room right away; you can't get there half quick enough to suit them, for the paper *must* be out, *it's got to be*." And he strutted off as though the world depended on him.

The boss was very busy, and there was a man waiting for the job that he had "nearly finished." "Here, Johnnie, you go down to the newspaper office, and go down into the press room, you will find it just down off from the street, and do what you can for them until I get there. Tell them that I will be down right away; that I only have a little bit to do to finish this job, and will have their job done long before they will need the press to print the paper to-night." It was a morning paper.

The boy found that the pressman had taken the press apart and was not able to get it together again. He had apparently taken off everything that would come off, and had the floor pretty well covered with the pieces. Here was a nice situation indeed, for a youngster that knew by hearsay that there was a machine that was

called a printing press, and that it was used in some way to print newspapers, and didn't know anything else worth mentioning, about it.

However, the boss had sent him down to do what he could, and his business was to stay, and at least make a try at doing something until the boss got there. He knew that boss well enough to know that it would not be exactly pleasant for him if he went back without doing anything. Besides that, he had caught enough of the spirit of the job shop not to want to go back.

The pressman was mad and rattled, as well as scared for fear that he would not be able to get the paper out at the usual time (and that is an unpardonable sin in a newspaper establishment) and did not act as if pleased to see the boy, who did his best to convey the impression that the boss was close behind, and would do the fine part of the job.

The press was one of the old fashioned kind where a platen runs back and forth under a cylinder. The platen carries the type, while the cylinder takes the paper. The cylinder was in place, but the pressman had become so excited and nervous that he could not tell which way it turned when the press was running. The boy examined the eccentric on the engine that ran the press to see which way the engine ran, and following the belt found out which way the press ran. That gave him a starting point, and piece after piece was "puzzled" on. In some cases the wear on the gear teeth gave a clew, sometimes looking over a smaller press in the room gave an idea and sometimes a piece was put on the right way just because it wouldn't go on the wrong way, but how he did wish that the boss would hurry up and get there.

Six o'clock came without any signs of the boss. No use of stopping for supper until he came, so hurry up and make a good showing and get a few more pieces on.

The little gripping mechanism, that catches the paper and pulls it onto the cylinder, proved the most troublesome part of the whole job. When the grips worked right, they didn't do it at the right time, and when the time was got right the tapes that held the paper were wrong, and when the tapes handled the paper right, the sticks that slapped them down onto the table were wrong.

Long before this seven, and then eight o'clock had come and gone, and the fear had come that something had happened to the boss and that he was not going to come at all. There was only one thing for it: *that press must be finished in time for the paper.* No time for supper now, no time or thought for anything but working. Slowly and carefully the press was pulled around again and again by hand, when everything was on, to see if it was safe to start it up, and it was with fear and trembling that at length the shipper was thrown over, and many stops had to be made and things adjusted before it was speeded up to full speed.

The first side of the paper was started on at eleven o'clock, but it was not until after it had all been printed and the press looked over again carefully that the boy thought it safe to leave the place; it was then two o'clock, and he had to be at the shop at six to fire up the boiler, for among his other duties he was chief engineer and fireman at the shop.

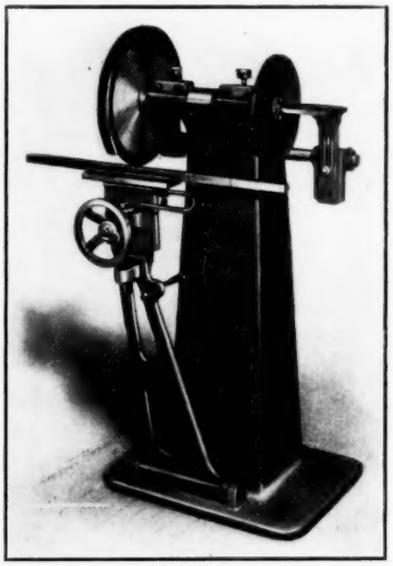
The boss looked the press over in the morning and found everything in good shape, and the next time the devil came to the shop after a man he said to the boss: "If you can't come right away, yourself, they want that young fellow that fixed the press the other night." And in the press room the boy that fed the papers to the press dropped his high and lofty air of disdainful superiority over everything that was not connected with a newspaper office, and treated with friendly respect the grimy "rat" from "that old junk shop." And "Johnnie" was ready to miss another supper when he couldn't avoid doing so.

W. OSBORNE.

Some New Things.

CUTTING-OFF MACHINE.

The half-tone illustrates a cutting-off machine which Armstrong Bros. Tool Company, of Chicago, Ill., are building for use on self-hardening steel, the machine being originally designed by them for the especial purpose of reducing bars of this stock to cutter lengths to suit their tool-holders. The cutting is done in this machine by a rapidly rotating disk of tool steel, which in use becomes coated at the periphery with self-hardening steel particles, these, it is believed, actually doing the cutting. The disk makes a clean cut in each side of the bar, and the piece is then readily broken off, and without the waste of time and material caused by breaking the stock on the anvil or in cutting it off hot. The spindle carries in addition to the cutting disk, a disk for grinding, this being 12 inches in diameter. The construction of the adjustable swing table and the method of holding, gaging and feeding the stock are clearly indicated in the engraving. The machine is equipped with countershaft, disks, breaking block, extra heavy emery cloth disks, etc.



CUTTING-OFF MACHINE.

VARIABLE SPEED GEAR FOR AUTOMOBILES.

J. W. Tygard, of Plainfield, N. J., has sent us a description of a variable speed automobile gear, of which we give three illustrations. The driven sprocket

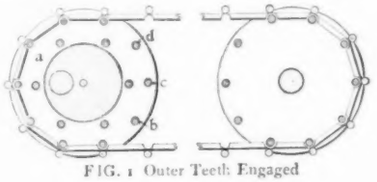


FIG. 1 Outer Teeth Engaged

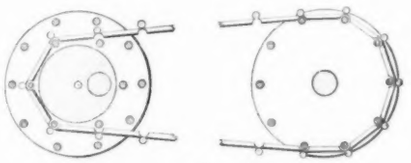


FIG. 2 Inner Teeth Engaged

FIG. 3 Pin Actuating Switch

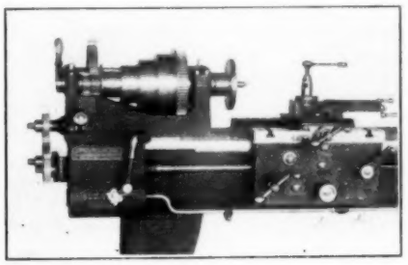
American Machinist

a has two (or more if desired) sets of pin teeth, of which the inner is fixed in position, while the outer may be slit endwise to bring them into engagement or disengagement at will. They are shown in engagement in Fig. 1, and to effect the disengagement they are, while passing the arc *bcd*, withdrawn in succession, thereby permitting the chain to engage with the inner set, as shown in Fig. 2. To accomplish this the pins have heads upon one end, which are acted upon by the switch shown in two positions in Fig. 3. It will be observed that between the engagements there is no free or coasting point, which is, we believe, peculiar to this gear. How the slack of the chain is taken care of we are not informed.

FOURTEEN-INCH LATHE.

The Seneca Falls Manufacturing Company, of Seneca Falls, N. Y., have brought out a new lathe. It swings over the shears 15¼ inches. A splined lead screw is used, the threads being used for screw cutting only. The screw is, however, gear driven under all circumstances, and three rates of feed are provided, each double the preceding. The changes of these feeds and the change from the feeding to the screw cutting gear are made by the hand lever shown at the left, a pointer on which leads to the word *fine, medium, coarse* or *threads*, as the case may be. With the

handle in the *thread* position the drive of the screw is direct, and not through the gears in the gear box. A tappet rod with adjustable stops is provided for automatically throwing out the feed which, however, will not operate when the hand lever points to *threads*. A new locking device



14-INCH LATHE.

for facing work is provided which is operated by the same lever that operates the feed screw split nut, making it impossible to close the nut without unlocking the carriage. Cross and longitudinal feeds are operated by the same hand knob, thus making it impossible to engage both feeds simultaneously.

A heavy traveling crane was put to excellent use in a recent emergency in a new steel plant at Birdsboro, Pa. Some accident in connection with the tapping of the furnace allowed the entire charge to run out. It encompassed the revolving table in front of the furnace, and if the metal had been allowed to set there it would of course have made a mass of scrap of it. The electric crane was hurriedly hitched to it, and it was pulled up by the roots, the metal adhering to it being knocked off and leaving it practically uninjured.

In the works of the C. H. Shaw Pneumatic Tool Company, Denver, Col., an air receiver recently exploded at 7.30 in the morning. The receiver was 42 inches in diameter and 12 feet long. At 9 o'clock the same day work was begun on a new receiver. The plates were selected and laid out, the heads were dished, the body, in two sheets, rolled and punched; the whole was assembled, riveted, caulked, tested and put in position and the pipes were connected by 6.30 P. M. of the same day.

M. Walther-Meunier has communicated to the Societe industrielle de Mulhouse some details of tests which he undertook on steam boiler plates used 30 or 40 years. From 731 tensile tests and various chemical analyses he finds that the metal is in great part corroded and destroyed, which once more goes to show the danger of using old material of this sort.

A total of 340,000 square feet of floor space are devoted to the manufacture of the Oldsmobile and to Olds gas engines, and it is expected that 10,000 Oldsmobiles will be built during the present year.

The Bagley & Sewall Company, Watertown, N. Y., are now building four Fourdrinier paper machines, said to be larger than any previously built. They are each 164 inches wide with a 70-foot wire, 3 presses and 32 dryers.

Personal.

C. A. Foster has resigned his position with the Lewiston (Maine) Machine Company to accept a position with the Geo. W. Stafford Company, of Readville, Mass.

Chas. W. Sponsel, a well known inventor and manufacturing expert, of Hartford, has opened a consulting engineering office in the Connecticut Mutual Building there, and is associated with Harry R. Williams, patent attorney.

F. A. Delano, general manager of the Chicago, Burlington & Quincy Railroad, gave an address before the engineering students of Purdue University upon "The Comparative Development of American and European Railways," on April 13.

H. E. Harris has resigned his position as chief draftsman with the Murray Manufacturing Company, Richmond Valley, Staten Island, and will go to Muskoka, Ontario, Canada, with his family for a four or five months' vacation, expecting to return to New York in the fall.

F. E. Drake, who was head of the American machinery department of the Paris Exposition, and since that time has been employed in connection with electrical industries in Germany, has been elected president of the Lanyon Zinc Company, and for a time, at least, will reside in the West.

Thos. F. Bowker, for the past eight years superintendent of the Strieby & Foote Company, of Newark, N. J., has resigned to take a similar position with the Iver Johnson's Arms and Cycle Works, of Fitchburg, Mass. On leaving the employees of the company presented him with a sterling silver fruit dish, suitably engraved, as a token of their esteem.

W. H. Whittemore, who for the past five years has been assistant superintendent of the Bullock Electric Manufacturing Company, of Cincinnati, Ohio, resigned his position April 4 to accept a position as general superintendent of the works of the Strieby & Foote Company, drop forgers, at Newark, N. J. Mr. Whittemore's associates at the Bullock Company presented him with a handsome silver service as a token of the high esteem in which he was held.

Obituary.

Engelbert Schwarz, for many years a foreman in the cylinder department of the Baldwin Locomotive Works, died in Philadelphia April 30, fifty-three years old.

George Willis Bement, of E. Bement's Sons, manufacturers of agricultural implements, Lansing, Mich., died April 19, fifty-three years old. He was a molder by trade, and assisted in building up the business which his father had founded.

David Bell, a pioneer ship and engine builder, of Buffalo, N. Y., died there April 20, eighty-five years old. He came to this country from Scotland in 1842, and forty years ago he had built up one of the then large works of the country. In 1866 he built four of the largest locomotives of their day.

Commander Julian St. Clair Ogden died in Philadelphia April 27, fifty-five years old. He had been in the engineer service of the Navy since 1866, and reached the grade of commander in 1899. Shortly after that he was detailed to duty in the Philippines and worked hard in looking after the engineering needs of the fleet at Cavite until in 1901 he was sent home on acount of severe illness. Since then he has acted as inspector of Government work at the Neafie & Levy shipyard.

Irving M. Scott, vice-president of the Union Iron Works, San Francisco, died suddenly of heart disease in that city, April 28, sixty-five years old. Mr. Scott's parents were Quakers, his father having a flour mill at Hebron Mills, Md., where the son was born. He was early interested in machinery, and went to Baltimore to learn the machinist's trade. Starting at $3 a week he soon became not only a machinist, but an expert draftsman and engineer. When 22 years old he went to San Francisco in charge of a steam fire engine and soon was in the employ of Peter Donohue, whose shops were called the Union Iron Works. He was given full charge of the works but refused an offered increase of wages until a current contract expired, when he demanded a much larger salary than had been offered, and obtained it. After obtaining an interest in the business and advancing it rapidly, he secured the assistance of Senator Fair in obtaining the contract for building the protected cruiser "Charleston." The Navy Department required unusual guarantees in connection with this contract, but it was successfully executed and other vessels followed, the cruiser "San Francisco," the monitor, "Monterey," Dewey's flagship, the "Olympia," and in 1893 the "Oregon," was launched. Several other ships have been built for the Government since, and two more are now under way in the yard. Mr. Scott designed and built the machinery for the Comstock mines, and had various patents for other inventions. He was interested in the larger educational movements and institutions and also in politics, his name having been presented at the convention which nominated Theodore Roosevelt for the Vice-Presidency.

Commercial Review.

NEW YORK, Monday, May 4, 1903.

The volume of trade in the machinery market during April showed a slight falling off by way of comparison with March. In the early part of the month many machinery men complained of a scarcity of orders, but toward the close of the month the influx of new business was of gratifying proportions. Still the trading done during the month was profitable. The month had many disturbing factors, the chief one being the probability of an upheaval in the labor world. Many machinery men at the beginning of the month were apprehensive of trouble with their employees, particularly around May 1, but the latter day passed without any disturbance occurring. At present everything seems to be serene in the machinery domain, so far as amicable relations between employers and employees are concerned.

The developments of the month showed plainly that there is considerable business in sight. This is particularly true of machine tools, inquiries in which were plentiful. One of the biggest machine tool men in the "street" informs us that he can put his hand on more new business now than he could at any time during the present year, and backed up his statement with pretty convincing data. There are many specifications being drafted now, which call for some good orders in machine tools. This is particularly true of railroads, who are very active nowadays in replacing old tools in their repair shops with those of latest design, and some of whom are going to erect new repair shops.

Prices in machine tools still remain firm. One hears nothing nowadays of selling at concessions. Of course there are always offenders in this line, but their ability to do mischief is gradually being curtailed. Deliveries, as a whole, have improved. We know, however, of a well known firm which has lost considerable business during the month, because it could not make satisfactory deliveries. This house carries a fine line of tools of several makes, and it was a case of the manufacturers being filled up with orders. On the other hand, it booked orders for tools, where those who gave them could have done better in the open market, both as regards price and delivery, but were determined to get the tool they wanted, no matter what sacrifice they had to make.

There is nothing new to report about the foreign machinery trade, although an order now and then shows that the possibilities for the sale of American machinery are not altogether lost sight of. Makers of electrical equipment are constantly receiving some good orders from the other side, which is true also of agricultural implement manufacturers. If it were not for these interests, our foreign machinery trade would be in a sorry plight, as the business done in other departments of the machinery trade is not what it should be. For this state of affairs various explanations are given, but the only one which seems to be universally recognized is, that American manufacturers either still continue to believe, or their attitude plainly shows that they have domestic business on hand now, and see sufficient in prospect, to not make Continental Europe the scene of any particular activity on their part.

Engine builders report a lull having taken place in their line recently, so far as new business is concerned. They say that there is plenty of orders in sight, but there's a hesitancy about giving them out, with various causes being assigned. As an example of how things have changed in the cost and erection of engines, the following statements of the representative of a well known engine concern are interesting:

"Three years ago I sold an engine to a man, and he came in to see me a few days ago to get a duplicate of it. He asked me for an estimate, and I gave it to him. It was $5,500. His eyes opened with astonishment, and after recovering his equanimity, he said: 'Why, you gave me the last engine for $3,800, and now you want $5,500 for the same engine.' Yes, I replied that was so, but he must remember that was three years ago, and everything that enters into the construction of an engine has gone up in price since then. The man then said: 'Well, what will you charge me for erecting it?' I named him a figure. 'Why,' he said, 'that's exactly three times what you charged me for erecting the old engine.' I told him he was right, but that three years ago carting could be had for $3.50 per ton, but now the minimum figure was $8 per ton. He was greatly surprised. This is an experience which engine men have frequently nowadays, where the prospective buyer bought his engine several years ago. Why, take freights. They have advanced considerably, and now you can send one engine across the country as cheaply as you can send a dozen, because the railroads won't allow you any rebate."

W. S. Accles, the European representative of the Niles-Bement-Pond Company, is now on a visit to this country. He is at present in Philadelphia, and will afterwards go West, returning to New York in about two weeks. Mr. Accles has taken some good orders for machine tools in England, Spain, Italy, and Australia, but reports that American machine tools are not in such good request in Germany and France as in the countries named. The domestic business of the Niles-Bement-Pond Company continues excellent. During April the company did not book as many large orders from railroad sources as it did during March, but its general business for the month was as good as any it has done for months. This company takes a very optimistic view of the machine tool outlook.

Collections during the month were the poorest of the year. Firms which have never been known to allow more than thirty days to pass without paying their bills, did not do so during the month. Uncle Sam has been a notable delinquent in this direction of late, and we know of a machinery house whose bill was presented and approved last October, but which has not been paid yet. This is one of the reasons why machinery men of limited capital are practically prevented from bidding on Government work. Municipal work has no attractions for them on this account also.

The Philadelphia Pneumatic Tool Company reports that sales to date for this year exceed those for the same period for last year by 39 per cent. and there seems to be no indication of a diminution in the demand for the Keller pneumatic tools. Mr. J. W. Tierney, president and treasurer of this company, has just returned from a five weeks tour of the far West and Pacific Coast, visiting the various branch offices and agencies of his company. New offices were established in the Cooper Building, Denver, Colo., in charge of Mr. W. E. Kreamer, and in the Dooley Block, Salt Lake City, in charge of Mr. F. E. Arnold. Mr. Tierney reports a very gratifying increase of trade in Colorado and particularly on the Pacific Coast. He says: "Sixteen months ago we had no agency on the Pacific Coast and our tools were practically unknown there. Now there is scarcely a shop in that part of the country which does not use our tools. It seems as though we are getting at least 80 per cent. of the pneumatic tool business of California, Oregon and Washington. The Mare Island Navy Yard has recently placed large orders with us for chippers, riveters and drills, the Keller tools having been specified in the requisition from the construction and repair department."

The Philadelphia Pneumatic Tool Company is represented in San Francisco by Berger, Carter & Co., No. 150 Beale street. This company also reports orders from Brooklyn Navy Yard for chipping and riveting hammers, also from the Lake Shore & Michigan Southern Railway, Westinghouse Air Brake Company, and American Car & Foundry Company. The demand for Keller pneumatic tools in Europe shows a steady growth also, particularly from Great Britain, Germany and Italy. A cable order was received recently from Chas. Churchill & Company, for a large lot of riveting hammers.

Only a short time since the National Tool Company was organized, and began business in a small room, in a modest way to specially treat steel and to manufacture lathe and planer tools from what has now become famous as "Omega steel." This steel has been on the market but a short time, but long enough to show its worth, as was evinced a short time since by their receiving a large order from one of the largest engine builders in Scotland. The company's business has grown

so fast, both in dimensions and volume from their home and foreign trade, that they were obliged to seek more capital and very much larger facilities to manufacture. A new $3,000,000 company has been formed which has now taken over the National Tool Company, and is known as the Omega Steel Company. A factory capable of turning out a much larger production has been secured, and they are now located on East street, New Haven, Conn. Plans have been prepared for a number of steel furnaces of the most improved pattern and they will be soon installed in their new plant; also, special machinery to manufacture twist drills, taps, reamers, and in fact, a full line of A-1 machinists' tools which will give employment to a large number of highly skilled mechanics. They have also in contemplation the erection of a large steel plant to manufacture their own steel, but the location has not been decided on as yet.

The Railway Appliances Company, manufacturers of the Q & C pneumatic tools, will shortly move from 114 Liberty street, to 107 Liberty street.

Owing to the necessity of obtaining more room, Robert W. Hunt & Co., have moved their New York office to No. 66 Broadway. Messrs. John J. Cone and James C. Hallsted, of the firm, sailed for Europe in the "Campania," on May 2, the former returning abroad after a few weeks visit home. Mr. Hallsted has gone over to give his personal supervision to the inspection of the structural material for two large London hotels, which has been awarded to this firm. These contracts, together with several others for buildings to be erected in England and South Africa, as well as the bridge material for this continent has compelled the firm to organize a foreign structural and bridge department in addition to the one in charge of rails, splice bars, billets, etc., etc.

The consolidation of the Webster, Camp & Lane Company, of Akron, Ohio, and the Wellman-Seaver-Morgan Engineering Company, of Cleveland, Ohio, under the corporate name of the Wellman-Seaver-Morgan Company, is officially announced. The general offices of the new Company will be located at Cleveland, Ohio, and to which address all general correspondence and remittances should be sent. Correspondence for the Akron plant should be addressed to that city.

CHICAGO MACHINERY MARKET.

There is some slowness in the completion of negotiations for the purchase of electrical machinery. Inquiries are numerous but some of them have been pending since the first of the year. Perhaps the activity is most marked just now in power for electric railway lines, a number of projects having lately been stimulated into life. Not for two months perhaps will the market for lighting plants, which are usually installed in autumn, reach its most active state. For general manufacturing purposes there is a good call for electrical machinery, but, as noted above, the prospective buyers are a little slow in bringing their negotiations to a close. Where previous installations have been made, there is a steady call for additional motors. The Chicago representative of one Western electrical machinery manufacturer says that during April he sold 237 motors, which has exceeded any previous month's business in the office. It was a well distributed trade.

Considerable interest is taken in the new shops of the Rock Island Road at Moline, Ill., ground for which has been broken. The building commenced will be 856x276 feet in size and will include the erecting, machine and boiler tank shops. It will be provided with seven electric cranes. A feature which is said to be somewhat novel is that the heavy punches, shears and riveting machines will be operated by hydraulic instead of electric power, the pumps to be operated under 1,500 pounds per square inch pressure. The riveter will be sunk in a pit, obviating the necessity of erecting a tower. This shop will have a capacity of repairing fifty locomotives at one time. The wood working shops will not be erected until next year. C. H. Wilmerding has been appointed the consulting engineer for the work. As previously stated the General Electric Company has secured the contract for the first generator of 600 kilowatts and another of 250 kilowatts. These are the only two that will be installed this year. Contracts for the motors have not yet been placed. There will be a number of individual motors and also a number of group motors.

Among the orders that have been closed in April by the Crocker-Wheeler Company are the following: A 150-kilowatt type generator for the Troy Laundry Machinery Company, Chicago; fourteen motors aggregating 185 horse-power, for the Great Northern Portland Cement Company, Baldwin, Mich.; motors of 46 horse-power for the National Cash Register Company, Dayton, Ohio; motors of 55-horse-power for the Schlesinger & Mayer building, Chicago; ten motors of 250 horse-power for the Allis-Chalmers Company, Milwaukee and Chicago deliveries, also orders from Armour & Co., East St. Louis; A. Booth & Co., Chicago; Chicago Junction Railway, Blue Island, Ill., and others.

Quotations

NEW YORK, Monday, May 4.

New York prices for Northern and Southern irons for nearby delivery are as follows:

Northern:	
No. 1 X	$21 50 @ $21 75
No. 2 X	20 25 @ 20 75
No. 2 plain	19 75 @ 20 25
Southern:	
No. 1 Foundry	21 50 @ 21 75
No. 2 Foundry	20 50 @ 20 75
No. 3 Foundry	19 50 @ 19 75
No. 4 Foundry	19 00 @ 19 25

Bar Iron—Base sizes—Refined brands, mill price on dock, 1.95c. upward in carload lots. Smaller quantities from store, 2.15@2.30c.

Tool Steel—Base sizes—Good standard quality, 7c.; extra grades, 10c. and upward.

Machinery Steel—Base sizes—From store, 2.10@2.25c.

Cold Rolled Steel Shafting—2.90c. from store for base sizes.

Copper—Lake Superior ingot 14¾@15c.; electrolytic, 14¾@15c.; casting, 14½@14¾c.

Pig Tin—In 5- and 10-ton lots, f. o. b. New York, 30.10@30.30c.

Spelter—5.00@5.75c.

Antimony—Cookson's, 7⅝@7⅞c.; Hallett's, 6¾@7c.; other brands, 6½@6¾c.

Lard Oil—Prime City, 83@85c. according to brand and quantity, ranging from one barrel up to large lots.

New Catalogs.

Wyman & Gordon, Worcester, Mass. Crank forgings. 4½x7, pp. 8, paper.

Waterbury Rope Co., 69 South street, New York. Price lists of manila and wire rope.

J. E. Snyder, Worcester, Mass. Drilling machines, 20 to 36 in. capacity. 6x9, pp. 63, paper.

Mossberg & Granville Manufacturing Company, Providence, R. I. Roller bearings. 5x7, pp. 54, paper.

H. F. Watson Company, Erie, Pa. Asbestos materials, cements, asbestos roofings. 3½x6, pp. 32, paper.

Baldwin Locomotive Works, Philadelphia, Pa. Record of recent construction, No. 39. 6x9, pp. 31, paper.

Herron & Bury Manufacturing Company, Erie, Pa. Bulletins Nos. 14, 15, 16, 17 and 18 of air compressors.

Columbus (Ohio) Steel Rolling Shutter Company. Steel rolling doors, shutters and partitions. 7¾x11, pp. 14, paper.

W. S. Quigley (general agent), The Bourse, Philadelphia, Pa. The "Charlier" patent rolling furnace, 4x9, pp. 19, paper.

Fay & Bowen, Auburn, N. Y. Gasoline motors and launches, illustrated and described in detail. 6x9, pp. 32, paper.

International Correspondence Schools, Scranton, Pa. "One Thousand and One Stories of Success," containing a list of over a thousand students who have benefited by courses in these schools. 6x9, pp. 47, paper.

Manufacturers.

The Rome (N. Y.) Metal Company is building a large plant.

The Sessions Clock Company will build a new shop in Forestville, Conn.

The Mengel Box Company, Louisville, Ky., will build a large veneering plant.

The Western Packing Company, Denver, Colo., will build a repair machine shop.

The Toledo (O.) Belting Company has let a contract for the erection of a factory.

The Southern Pacific has purchased land near Reno, Nev., for terminals, including shops.

The Republic Oil Company will build a plant to replace one burned in Chicago recently.

The foundry of the Pyott Foundry Company, Chicago, Ill., has been somewhat damaged by fire.

Ashley Horne, of Clayton, N. C., and others are interested in an enterprise to build an oil mill there.

Ground has been broken at Depew, N. Y., by the Gould Coupler Company for a new steel foundry.

Plans have been made for a plant of the National Peat Fuel Company, to be located at Chelsea, Mich.

The Trenton Water Power Company proposes to establish a big electric plant on the Delaware bank.

The Town Council, Martinsville, Va., is advertising for bids for an electric power and lighting franchise.

A new company, the Niagara Research Laboratories, proposes to erect a substantial plant at Niagara Falls, N. Y.

The Bukolt Manufacturing Company, wash machines, Stevens Point, Wis., proposes to erect a new factory building.

A canning factory, to be capitalized at $40,000, is proposed by Albert Montreuil, of Walkerville, Mich., and others.

Work has started at Brunswick, Ga., on the new steel plant, which, it is said, will cost something like $10,000,000.

The Arlington (Textile) Mills, Lawrence, Mass., propose to spend at least $2,000,000 in improvements within the next year.

The Napier (Tenn.) Iron Works has practically concluded the purchase of 900 acres of ore lands, which it proposes to develop.

The Rapid Transit Railway Company, Syracuse, N. Y., will build a large new car-house and turn one of the old ones into a shop.

Plans have been made for an addition to the plant of the Western Sand Blast Company, Chicago, manufacturer of stained glass, etc.

Senator Thomas and Mine Inspector Fenton, of Mahanoy City, Pa., will establish a factory at Mahanoy and manufacture stove pipe.

Thomas Hill, a cart manufacturer, of Railroad avenue, near Henderson street, Jersey City, is starting to build a series of factories, to rent.

Samuel Green & Sons, foundrymen and manufacturers of hot air furnaces, Des Moines, Ia., plan to increase the size of their factory.

The International Cork Seal Company, promoted by H. S. Brewington, is contemplating the erection of a factory in Baltimore, Md., or elsewhere.

The National Portland Cement Company, composed of Belvidere, N. J., capitalists and others, will, it is said, erect a $300,000 cement mill at Stewartsville, N. J.

The Pittsburgh Plate Glass Company is establishing a pressed brick plant at Kokomo, Ind., to utilize its waste sand, and if the scheme succeeds will build others elsewhere.

At Ebensburg, Pa., a company has been formed to build a brewery at Cresson by Joseph Henger and H. A. Englehart, of Ebensburg; Thomas Callan, of Cresson, and others.

The Monitor Forge & Iron Company is incorporating and will establish a plant at Sandusky, O., to manufacture drop forgings. Frank Sloane will be at the head of the concern.

It is reported that a factory at South Farms, Middletown, Conn., will be started up by the Liberty Wrench & Chuck Company, to manufacture a patent pipe wrench and drill chuck.

An estimate has been prepared for the construction of a large plant to be erected at New Kensington, Pa., for the Westmoreland Boiler Company. A foundry and machine shop, etc., will be erected.

It is reported that car building shops of the Atlanta & West Point Railroad and the Western Railway of Alabama, at Montgomery, Ala., will be removed to Atlanta, Ga., where large car and repair shops may be built.

B. B. Lathbury, of Philadelphia, and others will build a 1,500-barrel-a-day cement mill at Wellston, O., and a 3,000-barrel mill on the Eagle furnace lands, fourteen miles from Wellston. The concern will be known as the Alma Cement Company.

The American Ax & Tool Company, which recently completed a large plant at Glassport, Pa., is prepared to build an additional plant there. The New York plant was burned recently, and the company prefers to concentrate its works in the Pittsburgh district.

The Brightman Manufacturing Company, turned, rolled and polished shafting and shafting machinery, has removed its office and works to Shelby, O., where it has increased facilities. The company has much work on hand and reports prospects very bright.

The Logansport (Ind.) Foundry and the Rutenber Manufacturing Company, gas motors, etc., of that place have been united under the name Western Motor Company, with a capital stock of $400,000. The Rutenber company's building is to be enlarged, and the machine shop doubled.

At the West Albany shops of the New York Central & Hudson River Railroad a new erecting shop is being built. It is a steel frame structure and so much higher and larger than the old shop that the latter and its operations are left undisturbed within it until the new building is finished.

Kuhlo Manufacturing Company, of St. Paul, Minn., has just incorporated with $50,000 capital stock, and is beginning business to manufacture surveyors' instruments and optical and stereopticon supplies, etc. The incorporators are Arnold Kuhle, Walter H. Dickerman, C. D. Bruce Tudor.

It is stated at Seattle, Wash., that the Alaska Peninsula Packing Company, contain New York capital, is preparing plans in San Francisco for what will be the largest cannery of the sort in the world. The incorporators are Julian M. Platz, Reginald H. Schneck and K. K. McLaren, of New York.

The Wilson Laundry Machinery Company, Columbia, Pa., manufacturer of modern laundry machinery, is changing its works. It proposes to erect a one-story machine shop, containing 14,000 square feet of floor space, which will require new power plant of 100 horse-power boiler and 75 horse-power engine.

The Electro-Manganese Company has applied for a charter in New Brunswick, Can., and may establish a plant at Grand Falls for the reduction of bog ores. The applicants include Barton E. Kingman, of New York; Fred C. Sayles and Robt. W. Sayles, of Providence, R. I., and others. A steel plant may eventually be built also.

Iron men of Pittsburgh and West Virginia have organized the Paden Iron & Steel Company and the Paden Glass Company, with capitals of $100,000 and $50,000, respectively, for the new town of Paden, W. Va. The incorporators include Thomas A. Watkins, George R. Wallace, Robert Miller, Benjamin L. Hirshfield and John B. McAdoo, all of Pittsburgh.

The F. P. Smith Wire & Iron Works, 100 Lake street, Chicago, Ill., manufacturers of ornamental and structural iron, art brass and wire work, have been appointed sole agents in Chicago and several neighboring States for the Columbus (O.) Steel Rolling Shutter Company, manufacturers of steel rolling doors for freight houses, car barns, warehouses, etc.

Representatives of the Continuous Rail Joint Company of America have purchased about 20 acres of land at Troy, N. Y., with rolling mills, machine shops and other buildings formerly owned by the Troy Steel Company, part of which they have been operating under lease. The plant will hereafter be known as the Albany Iron & Steel Works Department of the Continuous Rail Joint Company of America. The output of the company will be increased. The general offices will remain in Newark, N. J.

It is reported from Atlanta, Ga., that the Bull Sluice Electric Company is negotiating with some large manufacturing concerns to locate at Bull Sluice, on the Chattahoochee, and use its power, and there is a rumor that "an extensive electrical machinery manufacturing plant is contemplated among them, probably either a branch of the world-famed Westinghouse Company or a new organization controlled by it." S. Morgan Smith, the president of the Bull Sluice company, is a manufacturer of water wheels at York, Pa.

Miscellaneous Wants.

Advertisements will be inserted under this head at 25 cents a line, each insertion. Copy should be sent to reach us not later than Saturday morning for the ensuing week's issue. Answers addressed to our care will be forwarded.

Grant. Gears. See upper corner, page 124.

Caliper cat. free. E. G. Smith, Columbia, Pa.

See the Lowe test indicator, page 117.

Punches & dies. Wal.M.Wks.,Waltham,Mass.

Patterns.—Cincinnati Pat. Wks., Cincin., O.

Stamping Dies. Emmons Collins, Chicago.

Stamping and punches and dies. F. H. Otis, Rochester, N. Y.

Drawings, patterns and models to order. Ashland Tool Co., Ashland, Pa.

Working drawings which are working. Geo. M. Mayer, M. E., Monadnock, Chicago.

Wanted—A second-hand shaper and milling machine. F. J. Croninger, Columbus, O.

Will buy or pay royalty for good patented machine or tool. Box 282, AMER. MACH.

Wanted—Improvements in grinding machinery. Address Box 1435, Providence, R. I.

Light and fine mach'y to order; models and elec. work specialty. E. O. Chase, Newark, N. J.

Automatic machinery designed and constructed by the Wellman Sole Cutting Machine Co., Medford, Mass.

Wanted—Competent managers, superintendents and foremen. James Brady, Room J, 20th Floor, 220 Broadway, New York.

Wanted—The address of John Bruderer, formerly of Lebanon, Pa. Address reply to "M 13," care AMERICAN MACHINIST.

Designing auto. mach'y tools for interchangeable work a specialty; drawings made at moderate prices. Box 943, New Haven, Ct.

Machinists—Send 10 cents for blueprint table of U. S. S. steam, gas and water pipe, giving tapping sizes. E. E. Meyer, Allegheny, Pa.

Wanted—Contract and jobbing work on medium and heavy weight machinery and parts; prompt delivery. U. S. Rapid-Fire Gun & Power Co., Derby Conn.

Wanted—Short contributions by practical power plant engineers for a publication for steam engineers; illustrated when possible. Technical Publishing Co., Burns Bldg., Detroit, Mich.

Machinists and toolmakers, send 50 cents for my Milling Machine Chart, 13x20, giving various useful tables and information. Address R. A. Lachmann, 4818 Calumet ave., Chicago, Ill.

Correspondence desired with manufacturers of small tools who can make use of a new cost-reducing method for making a much-used tool; tap and die makers should be interested. Address "Die," Box 225, AMER. MACHINIST.

Agency Wanted.—A university educated mechanical engineer with 18 years' experience, in leading position at present, and member of the American Society of Mechanical Engineers, wants to establish himself as a consulting engineer, connecting his office with good agencies. Address "Consulting Engineer," care AMERICAN MACHINIST.

For Sale.

Thurston milling machine for sale. Apply Stern Bros. & Co., 33-43 Gold st., New York City.

For Sale—8 sheets working drawings, 1¾ H.-P. bicycle motor, $2. W. S. Morrison, 228 W. 123d st., New York.

For Sale—Branch of machine tool line, well established 9 years, with domestic and foreign agencies, separate catalogs, etc., in machine tool center of the West; object, specializing. Address "Chance," care AMER. MACHINIST.

For Sale—An established and successful machinery manufacturing business in a town of 10,000 inhabitants; modern brick buildings, fine water power, good shipping facilities, etc.; satisfactory reasons for selling; a grand opportunity to the right party who can invest not less than $100,000 after the fullest investigation. Address "Macnlnery Manufacturer," care AMERICAN MACHINIST.

Wants.

Situation and Help Advertisements only inserted under this head. Rate 25 cents a line for each insertion. About six words make a line. No advertisements under two lines accepted, and no advertisements abbreviated. The cash and copy should be sent to reach us not later than Saturday morning for the ensuing week's issue. Answers addressed to our care will be forwarded. Applicants may specify names to which their replies are not to be forwarded; but replies will not be returned. If not forwarded they will be destroyed without notice. Original letters of recommendation or other papers of value should not be enclosed to unknown correspondents. State mentioned indicates present address of advertiser.

Situations Wanted.

CONNECTICUT.

Wanted—Position as superintendent, by head draftsman, now with a well-known firm, builders of metal-working machinery. Address Box 263, AMERICAN MACHINIST.

Mechanical engineer, Stevens graduate, age 38, experienced designer automatic machinery, gas engines, automobiles, tools, dies, fixtures, gages and methods of manufacture for interchangeable work, desires position as superintendent, mechanical engineer or chief draftsman. Address Box 257, AM. MACH.

ILLINOIS.

Wanted—Position as foreman or assistant superintendent, by first-class man of 15 years' experience; have handled 25 men on tool work; good references. Box 243, AM. MACH.

Mechanical engineers want positions; we have investigated their records and references; we can furnish competent men for all kinds of technical work. Engineering Agency, 19 Monadnock Block, Chicago.

Want position as manager or superintendent of large machine or boiler shops; held such a place 6 years; 4 years mechanical engineer of large manufacturing concern; now employed; technically educated; up on modern shop methods and accounting; references; will go anywhere. Box 199, AM. M.

INDIANA.

Wanted—Position of superintendent or general foreman of machine shop; 25 years' experience on general manufacturing and high-grade machinery and tool building; up to date on jigs and fixtures for duplicate work; references. Address Box 254, AMER. MACH.

MASSACHUSETTS.

Draftsman and designer, with 15 years' experience in machine shops and drawing rooms, wants to make a change. Box 262, AM. M.

Mechanical draftsman and practical machinist, with wide experience, desires responsible position about June 1. Box 260, A. M.

Young draftsman, with experience on machine tools, wishes position to improve in designing high-grade machine tools; has had shop experience. Box 247, AMER. MACH.

Technical graduate, with 12 years experience in machine shops and drawing rooms, wants to better himself; used to light and heavy work. Box 261, AMERICAN MACHINIST.

Patternmaker, 16 years' experience on heavy and light tools, thoroughly understands coring, capable of taking charge, would like to correspond with parties wanting A1 man. Box 248, AMERICAN MACHINIST.

MICHIGAN.

Young man, 28, desires change; would like position as assistant superintendent or in drafting room; is a good mechanic; technical graduate; 6 years' shop and and 3 years' drafting-room experience. Box 234, AM. M.

NEW HAMPSHIRE.

Blacksmith, first-class tool dresser, desires change within New England. Box 245, A. M.

NEW JERSEY.

Situation wanted as machine shop foreman or assistant superintendent; A1 references. Address J. E., care AMERICAN MACHINIST.

First-class designer of special tools and machinery, wide practical experience at the bench, toolmaking, foremanship and drafting room, will be open for change June 1; good reasons for changing. Box 238, AM. MACH.

NEW YORK.

Machine designer, etc., wants position. Address Box 63, AMERICAN MACHINIST.

Draftsman, technical graduate, 4 years' experience, wants position. Box 251, AM. M.

Draftsman, mechanical, 2 years' experience, desires position. Box 249, AMER. MACHINIST.

Cost clerk, up-to-date man, would like to make change; cost, premium and time systems. Box 232, AMERICAN MACHINIST.

A young man (26) desires clerical position with energetic manufacturer; good references. Box 252, AMERICAN MACHINIST.

Educated draftsman (age 24), 3 years' drafting-room, 2 years' shop experience, desires position. Box 250, AMER. MACHINIST.

Mechanical draftsman, university graduate, also had 2 years' shop practice, wants position; will go anywhere. Box 253, A. M.

Cost clerk and office manager of several years' experience, capable of installing up-to-date cost and premium systems, desires to make a change; pumping machinery preferred; highest reference. Box 231, AM. M.

Wanted—Position as foreman with reliable concern; varied experience; can handle help profitably and is a thorough mechanic; New York or Philadelphia preferred. Address O. K., care AMERICAN MACHINIST.

Wanted—Position as foreman in novelty manufacturing concern; 18 years' experience; first-class tool and die maker, also designer of labor-saving machinery; well accustomed to handling help; New York city or suburbs preferred. Box 255, AMERICAN MACHINIST.

As salesman or sales manager, for line of machine tools (single line or specialty preferred), by a young man with shop experience, now representing a general line with house in New York, but desires, for good reasons, to make a change; best of references. Box 233, AMERICAN MACHINIST.

Mechanical engineer, university graduate, with practical shop and business experience in foundry, smithy and machine shop, several years' designer's experience automatic machinery, electric cranes, presses, electric automobiles and trucks, now chief draftsman, seeks change or position as assistant superintendent. Box 229, AMERICAN MACHINIST.

OHIO.

Position wanted as foreman patternmaker by a man of large experience in making both wood and metal patterns; best of references given. Address "Pattern," care AM. MACH.

PENNSYLVANIA.

Position as superintendent; references from leading concerns. Box 224, AMER. MACH.

Machinist wants situation in Greater New York; experienced in tool, die, metal pattern and repair work; reference. Box 256, A. M.

A thoroughly practical man, not given to moving around, wants position as superintendent or general foreman; best references. Address Box 198, AMERICAN MACHINIST.

Mechanical and electrical engineer, technical graduate, first-class draftsman and designer, with 9 years' experience in drafting room and shop, wants position. Box 239, AMERICAN MACHINIST.

First-class machinist, with 9 years' all-round shop experience and 5 years looking after repairs and engineering, desires position with good firm, to look after machinery or shop; references on request. Box 246, AMERICAN MACHINIST.

Help Wanted.

ILLINOIS.

Draftsmen for all classes of work; over 200 actual vacancies for technical men in all parts of U. S.; 5,000 positions filled in 10 years. Engineering Agency, 19 Monadnock Block, Chicago.

We are constantly increasing the scope of our work, and invite applications for positions from first-class patternmakers, molders and machinists; we always have vacancies. Address Allis-Chalmers Co., Lock Box No. 1065, Chicago.

INDIANA.

Wanted—A good, all-round die-sinker on general drop forge work; state experience and pay expected. Address Box 244, AM. MACH.

MASSACHUSETTS.

Machinists wanted; good, all-round men on special automatic machinery; good pay and steady work. Apply to L. F. Fales, Walpole, Mass.

Wanted—Machinist for lathe and milling work, also young man for office work, also toolmaker for cutter work. Apply at Boston Gear Works, Boston, Mass.

Wanted—Experienced mechanical draftsman for steady position near Boston; state age, experience and salary expected. Address Box 228, AMERICAN MACHINIST.

Machine blacksmith wanted in a job shop near Boston; one who can run a lathe; good pay to a good, handy man; also wanted, milling machine hands. Box 205, AMER. MACH.

Draftsman wanted; leading man on structural steel work and factory buildings; state age, experience, references and salary expected. Address Box 207, AMER. MACHINIST.

MICHIGAN.

Wanted—First-class machinists and floor hands on press and die work, also good, all-around blacksmith on die and tool forgings. Address Michigan Machinery Mfg. Co., Ypsilanti, Mich.

NEW JERSEY.

Wanted—Experienced watch factory machine shop foreman; state age, experience, etc. Address "Foreman," care AMER. MACH.

Wanted—Lathe and planer hands for night work on heavy machine tool work; good wages to good men. Apply to The Pond Machine Tool Company, Plainfield, N. J.

Wanted—Mechanical draftsman on small machinery and tool work; applicants must furnish references and state age, experience and salary expected. Address Box 259, A. M.

Wanted—First-class foreman patternmaker, familiar with valve and fitting work; state age, experience and wages expected; good position to competent man. Address Box 241, AMERICAN MACHINIST.

Wanted—Foreman for drilling department on light, interchangeable work; applicants must furnish references and state age, experience and salary expected. Address Box 258, AMERICAN MACHINIST.

NEW YORK.

Several good draftsmen for permanent positions with a large concern in New York city. Box 223, AMERICAN MACHINIST.

Wanted—Mechanical draftsman, with special experience on light automatic machinery. Box 236, AMERICAN MACHINIST.

Wanted—All-round draftsmen; in writing, state age, references and salary expected. Eastman Kodak Company, Rochester, N. Y.

Wanted—Foreman toolmaker in Greater New York, familiar with steam pump, engine or air compressor work. Address Box 264, AMERICAN MACHINIST.

Wanted—Two first-class mechanical draftsmen, with 2 or 3 years' experience; give full particulars and salary expected. Address Box 242, AMERICAN MACHINIST.

Wanted—First-class lathe hands, all-round machinists and toolmakers; steady work; good pay. H. H. Franklin Mfg. Co., Automobile Dept., Syracuse, N. Y.

Wanted—Foreman for machine construction shop and toolroom of large manufacturing concern; permanent position, and good man desired. Box 237, AMER. MACHINIST.

Wanted—Machine constructor, one with good experience in building fine light machinery and handling men, to take charge of work and shop. Box 235, AMERICAN MACHINIST.

Toolmaker on screw job, as assistant foreman; must be experienced as to best methods on quality and quantity of products. Garvin Machine Co., Spring and Varick sts., New York.

Machinists wanted in a small manufacturing town, one hour's ride from New York city; wages $2.50 per day of 9 hours; time and a half for over time; factory employs about 300 men; has been in existence over 20 years, during which time it has never reduced wages or laid off men for lack of work; special inducements will be offered desirable men at this time; state nationality, age and experience for past 5 years. Box 200, AM. M.

OHIO.

Wanted—Lathe hands, planer hands, vise hands, milling machine hands; good wages and steady work. Apply to the Harris Automatic Press Company, Niles, O.

PENNSYLVANIA.

Experienced mechanical draftsman wanted; permanent employment assured to rapid and accurate draftsman. "Mill Work," care A. M.

Wanted—First-class designers for machine tool and special work; positions permanent; state experience and salary desired. Box 164, AMERICAN MACHINIST.

Machinists—First-class lathe men and en-

gine builder; steady work; permanent situations to right men. Call or address Keystone Driller Co., Beaver Falls, Pa.

Wanted—A first-class mechanical draftsman, familiar with compressor and engine design; state age, salary expected and reference. Box 218, AMERICAN MACHINIST.

Wanted—At once, several good mechanical draftsmen; work consists of application of motors to machine tools; state experience and salary expected. Box 240, AM. MACH.

Wanted—A foreman for erecting and testing floor in shop building high and medium speed engines; give details of experience, age, nationality and pay expected. Box 226, A. M.

Wanted—First-class foreman for machine shop; must have experience in building machine tools and interchangeable work; state experience and salary desired. Box 165, AMERICAN MACHINIST.

Wanted—Experienced foreman; must be thoroughly familiar with engine work and understand modern method of conducting shop and handling men. Address Box 230, AMERICAN MACHINIST.

We are constantly increasing the scope of our work, and invite application for positions from first-class patternmakers, molders and machinists; we always have vacancies. Address The Westinghouse Machine Company, East Pittsburgh, Pa.

Wanted—Superintendent for a growing plant manufacturing tools and employing 100 men; factory is new and has modern equipment and ideas; applicant must have mechanical ability, energy, experience and executive ability. Box 193, AMERICAN MACHINIST.

First-class, experienced mechanical draftsmen wanted at once; some of them acquainted with electrical work; those with shop experience preferred. Apply, by letter, to Chief Draftsman, P. O. Box 911, Pittsburg, Pa., stating experience in full and giving references.

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Patterson, Gottfried & Hunter, Ltd., New York.
Stuart, R. J., New Hamburg, N. Y.
Vandegrift Coupling Co., Evansville, Ind.

Cranes

Brown Hoisting Mach. Co., N. Y. City.
Case Mfg. Co., Columbus, O.
Chambersburg Engr. Co., Chambersburg, Pa.
Cleveland Crane & Car Co., Cleveland, O.
Curtis & Co. Mfg. Co., St. Louis, Mo.
Franklin Portable Crane & Hoist Co., Franklin, Pa.
Lane Mfg. Co., Montpelier, Vt.
Maris Bros., Philadelphia, Pa.
Niles-Bement-Pond Co., New York.
Northern Engineering Works, Detroit, Mich.
Obermayer Co., S., Cincinnati, O.
Pawling & Harnischfeger, Milwaukee, Wis.
Sellers & Co., Wm., Philadel., Pa.
Whiting Foundry Equipment Co., Harvey, Ill.

Crank Pin Turning Machine

Underwood & Co., H. B., Philadelphia, Pa.

Crucibles

Dixon Crucible Co., Jos., Jersey City, N. J.
Obermayer Co., S., Cincinnati, O.

Cupolas, and Ladles, Foundry

Byram & Co., Inc., Detroit, Mich.
Northern Engr. Works, Detroit, Mich.
Obermayer Co., S., Cincinnati, O.
Paxson Co., J. W., Philadel., Pa.
Whiting Foundry Equip. Co., Harvey, Ill.

Cutters, Milling

Becker-Brainard Milling Mach. Co., Hyde Park, Mass.
Brown & Sharpe Mfg. Co., Providence, R. I.
Cleveland Twist Drill Co., Cleveland, O.
Gay & Ward, Athol, Mass.
Ingersoll Milling Mach. Co., Rockford, Ill.
Morse Twist Drill & Mach. Co., New Bedford, Mass.
Rogers, John M., Boat, Gage & Drill Works, Gloucester City, N. J.
Standard Tool Co., Cleveland, O.
Whitney Mfg. Co., Hartford, Conn.

Cutting-off Machines

Bement, Miles & Co., New York.
Bignall-Keeler Mfg. Co., Edwardsville, Ill.
Brown & Sharpe Mfg. Co., Providence, R. I.
Davis Mach. Co., W. P., Rochester, N. Y.
Hurlbut-Rogers Mach. Co., South Sudbury, Mass.
Newton Mach. Tool Wks., Philadelphia, Pa.
Niles Tool Works Co., New York.
Pond Mach. Tool Co., New York.

Cutting-off Tools

Armstrong Bros. Tool Co., Chicago, Ill.
O. K. Tool Holder Co., Shelton, Conn.
Pratt & Whitney Co., Hartford, Conn.
Western Mfg. Co., Springfield, O.

Diamond Tools

Dickinson, Thos. L., New York.
Steel Set Diamond Co., New York.

Dies, Sheet Metal

Bliss Co., E. W., Brooklyn, N. Y.
Dellvouk & George, Chicago, Ill.
Hay-Budden Mfg. Co., Brooklyn, N. Y.
Perkins Mach. Co., So. Boston, Mass.

Dies, Threading, Opening

Errington, F. A., New York.
Geometric Drill Co., New Haven, Conn.
Jones & Lamson Mch. Co., Springfield, Vt.
Maines Mach. Co., Philadel., Pa.
Modern Tool Co., Erie, Pa.
Pratt & Whitney Co., Hartford, Conn.

Dowel Pins

Obermayer Co., S., Cincinnati, O.
Winkley Co., Hartford, Conn.

Drawing Boards and Tables

Alexander Mfg. Co., J. G., Grand Rapids, Mich.
Keuffel & Esser Co., New York.
Rich, J. & G., Philadelphia, Pa.

Drawing Instruments

Alteneder & Son, Theo., Phila., Pa.
Keuffel & Esser Co., New York.

Drilling Machines, Bench

Barnes Co., W. F. & John, Rockford, Ill.
Pratt & Whitney Co., Hartford, Conn.

Drilling Machines, Boiler

Aurora Tool Works, Aurora, Ind.
Baush Mch. Tool Co., Springfield, Mass.
Bement, Miles & Co., New York.
Bickford Drill & Tool Co., Cincinnati, O.
Dallett & Co., Thos. H., Phila., Pa.
Niles Tool Works Co., New York.
Pond Mach. Tool Co., New York.

Drilling Machines, Multiple Spindle

Baker Bros., Toledo, O.
Barnes Co., B. F., Rockford, Ill.
Barnes Co., W. F. & John, Rockford, Ill.
Barr, H. G., Worcester, Mass.
Baush Mch. Tool Co., Springfield, Mass.
Bement, Miles & Co., New York.
Bickford Drill & Tool Co., Cincinnati, O.
Dallett & Co., Thos. H., Phila., Pa.
Fairbanks Co., New York.
Fenn-Sadler Mach. Co., Hartford, Conn.
Garvin Mach. Co., New York.
Harrington, Son & Co., Edwin, Philadelphia, Pa.
McCabe, J. J., New York.
Marshall & Huschart Mchry. Co., Chicago, Ill.
National Automatic Tool Co., Dayton, O.
Newton Machine Tool Works, Philadelphia, Pa.
Niles Tool Works Co., New York.
Prentiss Tool & Supply Co., New York.
Woodward & Rogers Co., Hartford, Conn.

Drilling Machines, Pneumatic

Chicago Pneumatic Tool Co., Chicago, Ill.
Cleveland Pneu. Tool Co., Cleveland, O.
Phila. Pneumatic Tool Co., Philadelphia, Pa.
Railway Appliances Co., Chicago, Ill.
Rand Drill Co., New York.
Standard Ry. Equip. Co., St. Louis, Mo.

Drilling Machines, Portable

Dallett & Co., Thos. H., Philadelphia, Pa.
Hisey-Wolf Mch. Co., Cincin., O.

Drilling Machines, Radial

American Tool Wks. Co., Cin., O.
Baush Mch. Tool Co., Springfield, Mass.
Bement, Miles & Co., New York.
Bickford Drill & Tool Co., Cincinnati, O.
Cleveland Punch & Shear Works Co., Cleveland, O.
Dreses Mach. Tool Co., Cincin., O.
Fairbanks Co., New York.
Fosdick Mach. Tool Co., Cincin., O.
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Hill, Clarke & Co., Boston, Mass.
McCabe, J. J., New York.
Marshall & Huschart Mchry. Co., Chicago, Ill.
Mueller Mach. Tool Co., Cincin., O.
Niles Tool Works Co., New York.
Pond Mach. Tool Co., New York.
Prentiss Tool & Supply Co., New York.
Roos & Mill, Cincinnati, O.

Drilling Machines, Turret

Niles Tool Works Co., New York.
Quint, A. D., Hartford, Conn.
Vanderbeek Tool Works, Hartford, Conn.

Drilling Machines, Upright

American Tool Wks. Co., Cin., O.
Aurora Tool Works, Aurora, Ind.
Baker Bros., Toledo, O.
Barnes Co., B. F., Rockford, Ill.
Barnes Co., W. F. & John, Rockford, Ill.
Barr, H. G., Worcester, Mass.
Bement, Miles & Co., New York.
Blaisdell & Co., P., Worcester, Mass.
Brown & Zortman Mchry. Co., Pittsburg, Pa.
Cincinnati Mach. Tool Co., Cin., O.
Davis Mach. Co., W. P., Rochester, N. Y.
Fairbanks Co., New York.
Fosdick Mach. Tool Co., Cincinnati, O.
Gould & Eberhardt, Newark, N. J.
Harrington & Son Co., Edwin, Philadelphia, Pa.
Hill, Clarke & Co., Boston, Mass.
Hoefer Mfg. Co., Freeport Ill.
Knecht Bros. Co., Cincinnati, O.
Le Blond Mach. Tool Co., R. K., Cincinnati, O.
McCabe, J. J., New York.
Marshall & Huschart Mchry. Co., Chicago, Ill.
Niles Tool Works Co., New York.
New Haven Mfg. Co., New Haven, Conn.
Power & Speed Regulator & Mfg. Co., Kalamazoo, Mich.
Pratt & Whitney Co., Hartford, Conn.
Prentiss Tool & Supply Co., New York.
Sibley & Ware, South Bend, Ind.
Washburn Shops, Worcester, Mass.
Whitney Mfg. Co., Hartford, Conn.
Woodward & Rogers Co., Hartford, Conn.

Drills, Center

Pratt & Whitney Co., Hartford, Conn.
Slocomb Co., J. T., Providence, R. I.

Drills, Rail

Bement, Miles & Co., New York.
Niles Tool Works Co., New York.

Drills, Ratchet

Parker Co., Chas., Meriden, Conn.
Pratt & Whitney Co., Hartford, Conn.

Dynamos

C & C Electric Co., New York.
Christensen Engineering Co., Milwaukee, Wis.
Commercial Electric Co., Indianapolis, Ind.
Crocker-Wheeler Electric Co., Ampere, N. J.
Eck Dynamo & Motor Co., Belleville, N. J.
General Elec. Co., New York.
Jantz & Leist Elec. Co., Cincin., O.
Mechanical Appliance Co., Milwaukee, Wis.
Milwaukee Elec. Co., Milwaukee, Wis.
Northern Elec. Mfg. Co., Madison, Wis.
Robbins & Myers Co., Springfield, Ohio.
Roth Bros. & Co., Chicago, Ill.
Sprague Elec. Co., New York.
Storey Motor & Electric Co., Harrison, N. J.
Triumph Elec. Co., Cincinnati, O.
Western Electric Co., Chicago, Ill.
Westinghouse Electric & Mfg. Co., Pittsburgh, Pa.

Electrical Supplies

Commercial Electric Co., Indianapolis, Ind.
General Elec. Co., New York.
Milwaukee Elec. Co., Milwaukee, Wis.
Storey Motor & Electric Co., Harrison, N. J.
Triumph Elec. Co., Cincinnati, O.
Western Electric Co., Chicago, Ill.
Westinghouse Electric & Mfg. Co., Pittsburgh, Pa.

Elevators

Albro-Clem Elevator Co., Philadelphia, Pa.
Curtis & Co. Mfg. Co., St. Louis, Mo.
Howard Iron Wks., Buffalo, N. Y.
Morse, Williams & Co., Phila., Pa.

Emery Wheels
See Grinding Wheels.

Emery Wheel Dressers
Calder, Geo. H., Lancaster, Pa.
Dickinson, Thos. L., New York.

Enamel, Machinery
Felton, Sibley & Co., Phila., Pa.
U. S. Gutta Percha Paint Co., Providence, R. I.

Enclosures, Tool-room
Merritt & Co., Philadelphia, Pa.

Engines, Automobile
Olds Motor Works, Lansing, Mich.

Engines, Gas and Gasoline
Backus Water Motor Co., Newark, N. J.
Bay State Gas Engine Co., Boston, Mass.
Foos Gas Eng. Co., Springfield, O.
Hamilton Motor Works, Hamilton, Canada.
Middletown Mach. Co., Middletown, O.
Mietz, August, New York.
New Era Iron Wks., Dayton, O.
Olds Motor Wks., Lansing, Mich.
Struthers-Wells Co., Warren, Pa.

Engines, Steam
American Blower Co., Detroit Mich.
Buffalo Engine Co., Buffalo, N. Y.
Frick Co., Waynesboro, Pa.
Garden City Fan Co., Chicago, Ill.
Rand Drill Co., New York.
Struthers-Wells Co., Warren, Pa.

Exhaust Heads
Burt Mfg. Co., Akron, O.

Factory Sites
Cincinnati Industrial Bureau, Cincinnati, O.

Fans, Electric
General Electric Co., New York.
Northern Elec. Mfg. Co., Madison, Wis.
Sprague Elec. Co., New York.
Western Electric Co., Chicago, Ill.
Westinghouse Elec. & Mfg. Co., Pittsburgh, Pa.

Fans, Exhaust
American Blower Co., Detroit, Mich.
Buffalo Forge Co., Buffalo, N. Y.
Garden City Fan Co., Chicago, Ill.

Feed Water Heater and Purifier
Hawley Down Draft Furnace Co., Chicago, Ill.

Files and Rasps
Barnett Co., G. & H., Phila., Pa.
Hammacher, Schlemmer & Co., New York.
Nicholson File Co., Provi., R. I.
Patterson, Gottfried & Hunter, Ltd., New York.

Filing Machines
Cochrane-Bly Mach. Co., Rochester, N. Y.

Fillers, Oil Can
The Winkley Co., Hartford, Conn.

Filters, Oil
Burt Mfg. Co., Akron, O.

Fittings, Steam
Crane Co., Chicago, Ill.
Crosby Steam Gage & Valve Co., Boston, Mass.
Jenkins Bros., New York.
Lunkenheimer Co., Cincinnati, O.
Walworth Mfg. Co., Boston, Mass.

Flexible Shafts
Chicago Flexible Shaft Co., Chicago, Ill.
Stow Mfg. Co., Binghamton, N. Y.

Forges
Buffalo Forge Co., Buffalo, N. Y.
Miner & Peck Mfg. Co., New Haven, Conn.
Patterson, Gottfried & Hunter, Ltd., New York.

Forgings, Hydraulic
Wyman & Gordon, Worcester, Mass.

Forgings, Drop
Billings & Spencer Co., Hartford, Conn.
M'ner & Peck Mfg. Co., New Haven, Conn.
Wyman & Gordon, Worcester, Mass.

Forgings, Steel
Hay-Budden Mfg. Co., Brooklyn, N. Y.
Pittsburg Shear Knife & Mach. Co., Pittsburg, Pa.
Westmoreland Steel Co., Pittsburg, Pa.
Wyman & Gordon, Worcester, Mass.

Foundry Furnishings
Byram & Co., Detroit, Mich.
Obermayer Co., S., Cincinnati, O.
Paxson Co., J. W., Philadel., Pa.
Smith Fdry. Supply Co., J. D., Cleveland, O.
Vulcan Facing Co., Easton, Pa.
Whiting Foundry Equip. Co., Harvey, Ill.

Furnaces, Coal and Oil
Buffalo Forge Co., Buffalo, N. Y.
Hawley Down Draft Furnace Co., Chicago, Ill.
Jacobson Mach. Mfg. Co., Warren, Pa.
Obermayer Co., S., Cincinnati, O.

Furnaces, Gas
Am. Gas Furnace Co., N. Y., City.
Chicago Flexible Shaft Co., Chicago, Ill.
Westmacott Co., J. M., Providence, R. I.

Furniture, Machine Shop
New Britain Mach. Co., New Britain, Conn.

Gages, Recording
Bristol Co., Waterbury, Conn.

Gages, Standard
Brown & Sharpe Mfg. Co., Providence, R. I.
Rogers, John M., Boat, Gage & Drill Works, Gloucester City, N. J.
Sawyer Tool Mfg. Co., Fitchburg, Mass.
Slocomb Co., J. T., Prov., R. I.
Starrett Co., L. S., Athol, Mass.

Gages, Steam
Crosby Steam Gage & Valve Co., Boston, Mass.

Gear Cutting Machinery
Becker-Brainard Milling Mach. Co., Hyde Park, Mass.
Bickford Drill & Tool Co., Cin., O.
Brown & Sharpe Mfg. Co., Providence, R. I.
Bultman & Co., F. W., Cleveland, Ohio.
Fellows Gear Shaper Co., Springfield, Vt.
Gleason Tool Co., Rochester, N. Y.
Gould & Eberhardt, Newark, N. J.
Harrington & Son Co., Edwin, Philadelphia, Pa.
Newton Mch. Tool Wks., Phil., Pa.
Niles Tool Works Co., New York.
Walcott & Son, Geo. D., Jackson, Mich.
Whiton Machine Co., D. E., New London, Conn.

Gears, Cut
Bilgram, Hugo, Philadelphia, Pa.
Boston Gear Works, Boston, Mass.
Brown & Sharpe Mfg. Co., Providence, R. I.
Bultman & Co., F. W., Cleveland, Ohio.
Fawcus Mach. Co., Pittsburgh, Pa.
Fellows Gear Shaper Co., Springfield, Vt.
Gleason Tool Co., Rochester, N. Y.
Gould & Eberhardt, Newark, N. J.
Grant Gear Works, Boston, Mass.
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Horsburgh & Scott Co., The, Cleveland, O.
Messmer Mfg. Co., Ferd., St. Louis, Mo.
New Process Raw Hide Co., Syracuse, N. Y.
Nuttall Co., R. D., Pittsburgh, Pa.
Patterson, Gottfried & Hunter, Ltd., New York.
Philadelphia Gear Works, Philadelphia, Pa.
Sawyer Gear Wks., Cleveland, O.
Simonds Mfg. Co., Pittsburgh, Pa.
Walcott & Son, Geo. D., Jackson, Mich.

Gears, Molded
Caldwell & Son Co., H. W., Chicago, Ill.
Farrel Fdry. & Mach. Co., Ansonia, Conn.
Franklin Mfg. Co., Syracuse, N. Y.
Greenwald Co., I. & E., Cincin., O.

Gears, Rawhide
Chicago Raw Hide Co., Chicago, Ill.
Fawcus Mch. Co., Pittsburgh, Pa.
Horsburgh & Scott Co., Cleveland, Ohio.
New Process Raw Hide Co., Syracuse, N. Y.
Nuttall Co., R. D., Pittsburgh, Pa.

Gears, Worm
Albro-Clem Elevator Co., Philadelphia, Pa.
Fawcus Mach. Co., Pittsburgh, Pa.
Morse, Williams & Co., Phila., Pa.
Nuttall Co., R. D., Pittsburgh, Pa.
Simonds Mfg. Co., Pittsburgh, Pa.

Graphite
Dixon Crucible Co., Jos., Jersey City, N. J.
Lubriphite Co., Jersey City, N. J.
Obermayer Co., S., Cincinnati, O.

Grinders, Center
Heald & Son, L. S., Barre, Mass.
Hisey-Wolf Mach. Co., Cincin., O.

Grinders, Cock
Windsor Mach. Co., Windsor, Vt.

Grinders, Cutter
Adams Co., Dubuque, Iowa.
Automatic Mach. Co., Greenfield, Mass.
Becker-Brainard Milling Mach. Co., Hyde Park, Mass.
Brown & Sharpe Mfg. Co., Providence, R. I.
Cincinnati Milling Mach. Co., Cincinnati, O.
Garvin Machine Co., New York.
Norton Emery Wheel Co., Worcester, Mass.
Pratt & Whitney Co., Hartford, Conn.
Rivett-Lock Co., Boston, Mass.
Woodward & Rogers Co., Hartford, Conn.

Grinders, Disc
Besly & Co., Chas. H., Chicago, Ill.
Gorton Mach. Co., Geo., Racine Wis.
Iroquois Mach. Co., New York.
Ransom Mfg. Co., Oshkosh, Wis.

Grinders, Drill
Gorton Mach. Co., Geo., Racine, Wis.
Heald & Son, L. S., Barre, Mass.
Standard Tool Co., Cleveland, O.
Washburn Shops, Worcester, Mass.
Wilmarth & Morman Co., Grand Rapids, Mich.

Grinders, Tool
Barnes Co., B. F., Rockford, Ill.
Barnes Co., W. F. & John, Rockford, Ill.
Barr, H. G., Worcester, Mass.
Brown & Sharpe Mfg. Co., Providence, R. I.
Diamond Mach. Co., Provi., R. I.
Gisholt Mach. Co., Madison, Wis.
Landis Tool Co., Waynesboro, Pa.
Modern Tool Co., Erie, Pa.
Northampton Emery Wheel Co., Leeds, Mass.
Ransom Mfg. Co., Oshkosh, Wis.
Safety Emery Wheel Co., Springfield, O.
Throop Perforating Co., Buffalo, N. Y.
Whitney Mfg. Co., Hartford, Ct.

Grinding Machines
Blount & Co., J. G., Everett, Mass.
Brown & Sharpe Mfg. Co., Providence, R. I.
Builders' Iron Foundry, Providence, R. I.
Diamond Mach. Co., Prov., R. I.
Fairbanks Co., New York.
Falkenau-Sinclair Co., Phila., Pa.
Goodell-Pratt Co., Greenfield, Mass.
Gorton Mach. Co., Geo., Racine, Wis.
Greenfield Mach. Co., Greenfield, Mass.
Hill, Clarke & Co., Boston, Mass.
Hisey-Wolf Mch. Co., Cincin., O.
Iroquois Mach. Co., New York.

Grinding Machines—*Cont'd*
Landis Tool Co., Waynesboro, Pa.
Marshall & Huschart Mchry. Co., Chicago, Ill.
Mechanical Appliance Co., Milwaukee, Wis.
Northampton Emery Wheel Co., Leeds, Mass.
Norton Emery Wheel Co., Worcester, Mass.
Norton Grinding Co., Worcester, Mass.
Prentiss Tool & Supply Co., New York.
Ransom Mfg. Co., Oshkosh, Wis.
Safety Emery Wheel Co., Springfield, Ohio.
Throop Perforating Co., Buffalo, N. Y.
Vitrified Wheel Co., Westfield, Mass.
Washburn Shops, Worcester, Mass.
Webster & Perks Tool Co., Springfield, O.
Wilmarth & Morman Co., Grand Rapids, Mich.
Woodward & Rogers Co., Hartford, Conn.

Grinding Wheels
Builders' Iron Foundry, Providence, R. I.
Carborundum Co., Niagara Falls, N. Y.
Diamond Mach. Co., Provi., R. I.
Hampden Cor. Wheel Co., Brightwood, Mass.
Northampton Emery Wheel Co., Leeds, Mass.
Norton Emery Wheel Co., Worcester, Mass.
Safety Emery Wheel Co., Springfield, O.
Vitrified Wheel Co., Westfield, Mass.
Whitney Mfg. Co., Hartford, Conn.

Grindstones and Frames
Cleveland Stone Co., Cleveland, O.
Standard Tool Co., Athol, Mass.

Gun Barrel Machinery
Bement, Miles & Co., New York.
Diamond Mach. Co., Provi., R. I.
Niles Tool Works Co., New York.
Pond Mach. Tool Co., New York.
Reed Co., F. E., Worcester, Mass.

Hack Saw Blades and Frames
Diamond Saw & Stamping Wks., Buffalo, N. Y.
Goodell-Pratt Co., Greenfield, Mass.
Hammacher, Schelmmer & Co., New York.
Millers Falls Co., New York.
Patterson, Gottfried & Hunter, Ltd., New York.
Starrett Co., L. S., Athol, Mass.
West Haven Mfg. Co., New Haven, Conn.

Hack Saws, Power
Diamond Saw & Stamping Wks., Buffalo, N. Y.
Hoefer Mfg. Co., Freeport, Ill.
Millers Falls Co., New York.
Olmsted, L. H., Hasbrouck Heights, N. J.
Resek Machine Tool Co., Cleveland, O.
West Haven Mfg. Co., New Haven, Conn.

Hammers, Drop
Bement, Miles & Co., New York.
Billings & Spencer Co., Hartford, Conn.
Bliss Co., E. W., Brooklyn, N. Y.
Miner & Peck Mfg. Co., New Haven, Conn.
Mossberg & Granville Mfg. Co., Providence, R. I.
Perkins Mach. Co., Boston, Mass.
Williams, White & Co., Moline, Ill.

Hammers, Pneumatic
Chicago Pneumatic Tool Co., Chicago, Ill.
Cleveland Pneumatic Tool Co., Cleveland, O.
Dallett & Co., Thos. H., Phila., Pa.
Phila. Pneu. Tool Co., Philadelphia, Pa.
Railway Appliances Co., Chicago, Ill.
Rand Drill Co., New York.
Standard Ry. Equip. Co., St. Louis, Mo.

Hammers, Power
Scranton & Co., The, New Haven, Conn.

Hammers, Steam

Bement, Miles & Co., New York.
Bethlehem Fdry. & Mach. Co., So. Bethlehem, Pa.
Chambersburg Engr. Co., Chambersburg, Pa.
Cleveland Punch & Shear Wks. Co., Cleveland, O.
Pittsburg Shear Knife & Mach. Co., Pittsburgh, Pa.

Heating and Ventilating Apparatus

Amer. Blower Co., Detroit, Mich.
Buffalo Forge Co., Buffalo, N. Y.
Garden City Fan Co., Chicago, Ill.

Heating Machines, Automatic

Am. Gas Furnace Co., New York.

Hoisting and Conveying Machinery

Brown Hoisting Mchry. Co., New York.
Caldwell & Son Co., H. W., Chicago, Ill.
Hunt Co., C. W., West New Brighton, N. Y.
Link Belt Engineering Co., Philadelphia, Pa.
Niles-Bement-Pond Co., New York.

Hoists, Electric

C & C Electric Co., New York.
Hunt Co., C. W., West New Brighton, N. Y.
Northern Engineering Works, Detroit, Mich.
Pawling & Harnischfeger, Milwaukee, Wis.
Sprague Electric Co., New York.

Hoists, Hand

Harrington, Son & Co., Edwin, Philadelphia, Pa.
Yale & Towne Mfg. Co., New York.

Hoists, Pneumatic

Chicago Pneumatic Tool Co., Chicago, Ill.
Cleveland Pneumatic Tool Co., Cleveland, O.
Curtis & Co. Mfg. Co., St. Louis, Mo.
Northern Engineering Wks., Detroit, Mich.
Rand Drill Co., New York.

Igniters, Gas Engine

Dayton Electrical Mfg. Co., Dayton, O.

Indicators, Speed

Starrett Co., L. S., Athol, Mass.

Indicators, Steam

Crosby Steam Gage & Valve Co., Boston, Mass.

Injectors

Lunkenheimer Co., Cincinnati, O.
Rue Mfg. Co., Philadelphia, Pa.
Sellers & Co., Wm., Phila., Pa.

Inspection and Tests

Hunt Co., Robt. W., Chicago, Ill.

Instruction Schools

See Schools, Correspondence.

Insurance, Boiler

Hartford Steam Boiler Insp. & Ins. Co., Hartford, Conn.

Iron Filler

U. S. Gutta Percha Paint Co., Providence, R. I.

Jacks, Hydraulic

Bethlehem Fdry. & Mch. Co., So. Bethlehem, Pa.
Watson-Stillman Co., New York.

Jack Planer

Armstrong Bros. Tool Co., Chicago, Ill.

Key Seaters

Baker Bros., Toledo, O.
Bement, Miles & Co., New York.
Chattanooga Mchry. Co., Chattanooga, Tenn.
Davis Mach. Co., W. P., Rochester, N. Y.
Hill Tool Co., Anderson, Ind.
Mitts & Merrill, Saginaw, Mich.
Whitney Mfg. Co., Hartford, Conn.

Keys, Machine

Standard Gauge Steel Co., Beaver Falls, Pa.
Whitney Mfg. Co., Hartford, Ct.

Knives, Solid Steel Shear

Pittsburg Shear Knife & Mach. Co., Pittsburg, Pa.

Lamps, Arc

General Electric Co., N. Y. City.
Western Electric Co., Chicago, Ill.
Westinghouse Elec. & Mfg. Co., Pittsburgh, Pa.

Lathe Attachments

National Machine Tool Co., Cincinnati, O.

Lathe Dogs

Armstrong Bros. Tool Co., Chicago, Ill.
Besly & Co., Chas. H., Chicago, Ill.
Hill Tool Co., Anderson, Ind.
Le Count, Wm. G., So. Norwalk, Conn.
Pratt & Whitney Co., Hartford, Conn.
Tindel-Morris Co., Eddystone, Pa.

Lathes

Affleck, Geo. E., New York.
American Tool Wks. Co., Cin., O.
Automatic Mach. Co., Greenfield, Mass.
Barker & Co., Wm., Cincin., O.
Barnes Co., B. F., Rockford, Ill.
Barnes Co., W. F. & John, Rockford, Ill.
Bement, Miles & Co., New York.
Blaisdell & Co., P., Worcester, Mass.
Blount & Co., J. G., Everett, Mass.
Bradford Mach. Tool Co., Cin., O.
Brown & Zortman Mchry. Co., Pittsburg, Pa.
Bullard Mach. Tool Co., Bridgeport, Conn.
Davis Mach. Co., W. P., Rochester, N. Y.
Diamond Machine Co., Prov., R. I.
Draper Mach. Tool Co., Worcester, Mass.
Fairbanks Co., New York.
Falkenau-Sinclair Co., Phila., Pa.
Fay & Scott, Dexter, Me.
Flather & Co., Nashua, N. H.
Garvin Mach. Co., New York.
Greaves, Klusman Co., Cincin., O.
Hardinge Bros., Chicago, Ill.
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Hendey Mach. Co., Torrington, Ct.
Hill, Clarke & Co., Boston, Mass.
Le Blond Mach. Tool Co., R. K., Cincinnati, O.
Lodge & Shipley Mch. Tool Co., Cincinnati, O.
McCabe, J. J., New York.
Marshall & Huschart Mchry. Co., Chicago, Ill.
Milwaukee Machine Tool Co., Milwaukee, Wis.
New Haven Mfg. Co., New Haven, Conn.
Niles Tool Works Co., New York.
Pond Mach. Tool Co., New York.
Pratt & Whitney Co., Hartford, Conn.
Prentiss Tool & Supply Co., New York.
Reed Co., F. E., Worcester, Mass.
Schumacher & Boye, Cincinnati, Ohio.
Sebastian Lathe Co., Cincin., O.
Seneca Falls Mfg. Co., Seneca Falls, N. Y.
Shepard Lathe Co., Cincin., O.
Walcott & Son., Geo. D., Jackson, Mich.
Washburn Shops, Worcester, Mass.

Lathes, Automatic Screw-Threading

Automatic Machine Co., Bridgeport, Conn.

Lathes, Bench

Faneuil Watch Tool Co., Boston, Mass.
Fenn-Sadler Mach. Co., Hartford, Conn.
Loop-Lock Mach. Co., Waltham, Mass.
Waltham Watch Tool Co., Springfield, Mass.

Lathes, Boring

Streit Mach. Co., A., Cincin., O.

Letters, Pattern

Brim, A. W., Seneca Falls, N. Y.
Butler, A. G., N. Y. City.

Levels

Mass. Tool Co., Greenfield, Mass.
Starrett Co., L. S., Athol, Mass.

Lockers, Clothes

Merritt & Co., Philadelphia, Pa.
Narragansett Mach. Co., Providence, R. I.

Locomotives, Shop

Hunt Co., C. W., West New Brighton, N. Y.

Lubricants

Besly & Co., Chas. H., Chicago, Ill.
Dixon Crucible Co., Jos., Jersey City, N. J.
Lubriphite Co., Jersey City, N. J.

Lubricators

Besly & Co., Chas. H., Chicago, Ill.
Bowen Mfg. Co., Auburn, N. Y.
Crane Co., Chicago, Ill.
Lubriphite Co., Jersey City, N. J.
Lunkenheimer Co., Cincinnati, O.

Machine Screws

Atlantic Mach. Screw Co., Boston, Mass.
Worcester Mach. Screw Co., Worcester, Mass.

Machinery Builders, Special

American Fdry. & Mach. Co., Hanover, Pa.
Blanchard Mach. Co., The, Boston, Mass.
Eclipse Mach. Co., Cleveland, O.
Fawcus Mch. Co., Pittsburgh, Pa.
Hart, Fredk., Poughkeepsie, N. Y.
Hoefer Mfg. Co., Freeport, Ill.
Power & Speed Regulator Mfg. Co., Kalamazoo, Mich.
Pratt & Whitney Co., Hartford, Conn.
Simonds Mfg. Co., Pittsburgh, Pa.
Wade Mach. Works, Walter H., Boston, Mass.
Williams Tool Co., Erie, Pa.
Woodward & Rogers Co., Hartford, Conn.

Machinists' Small Tools

Besly & Co., Chas. H., Chicago, Ill.
Billings & Spencer Co., Hartford, Conn.
Brown & Sharpe Mfg. Co., Providence, R. I.
Cleveland Twist Drill Co., Cleveland, O.
Hammacher, Schlemmer & Co., New York.
Lowe, H. A., Waltham, Mass.
McCrosky, F. B., Cincinnati, O.
Mass. Tool Co., Greenfield, Mass.
Patterson, Gottfried & Hunter, Ltd., New York.
Sawyer Tool Mfg. Co., Fitchburg, Mass.
Slocomb Co., J. T., Provi., R. I.
Smith, E. G., Columbia, Pa.
Standard Tool Co., Athol, Mass.
Standard Tool Co., Cleveland, O.
Starrett Co., L. S., Athol, Mass.

Machinists' Supplies

Hammacher, Schlemmer & Co., New York.
Patterson, Gottfried & Hunter, Ltd., New York.

Mandrels, Expanding

Nicholson & Son, W. H., Wilkesbarre, Pa.

Mandrels, Solid

Cleveland Twist Drill Co., Cleveland, O.
Morse Twist Drill & Mach. Co., New Bedford, Mass.
Rogers, John M., Boat, Gage & Drill Works, Gloucester City, N. J.
Standard Tool Co., Cleveland, O.

Measuring Machines

Rogers, John M., Boat, Gage & Drill Works, Gloucester City, N. J.

Metal, Bearing

Besly & Co., Chas. H., Chicago, Ill.
Patterson, Gottfried & Hunter, Ltd., New York.
Phosphor Bronze Smelting Co., Philadelphia, Pa.

Metal, Perforated

Throop Perforating Co., Buffalo, N. Y.

Micrometer Calipers

Brown & Sharpe Mfg. Co., Providence, R. I.
Sawyer Tool Mfg. Co., Fitchburg, Mass.
Slocomb Co., J. T., Providence, R. I.
Starrett Co., L. S., Athol, Mass.
Syracuse Twist Drill Co., Syracuse, N. Y.

Milling Attachments

The Adams Co., Dubuque, Iowa.
Becker-Brainard Milling Mach. Co., Hyde Park, Mass.
Brown & Sharpe Mfg. Co., Providence, R. I.
Cincinnati Milling Mach. Co., Cincinnati, O.
Whitney Mfg. Co., Hartford, Conn.

Milling Machines, Bench

Faneuil Watch Tool Co., Boston, Mass.
Hill, Clarke & Co., Boston, Mass.
Loop-Lock Mach. Co., Waltham, Mass.
Waltham Watch Tool Co., Springfield, Mass.

Milling Machines, Horizontal

Adams Co., Dubuque, Iowa.
Beaman & Smith Co., Prov., R. I.
Becker-Brainard Milling Mach. Co., Hyde Park, Mass.
Bement, Miles & Co., New York.
Hendey Mach. Co., Torrington, Ct.
Ingersoll Mill. Mach. Co., Rockford, Ill.
Newton Mach. Tool Wks., Philadelphia, Pa.
Niles Tool Works Co., New York.
Pratt & Whitney Co., Hartford, Conn.

Milling Machines, Plain

American Tool Wks. Co., Cin., O.
Aurora Tool Works, Aurora, Ind.
Becker-Brainard Milling Mach. Co., Hyde Park, Mass.
Bement, Miles & Co., New York.
Brown & Sharpe Mfg. Co., Providence, R. I.
Cincinnati Milling Mach. Co., Cincinnati, O.
Fairbanks Co., New York.
Garvin Mach. Co., New York.
Hendey Mach. Co., Torrington, Ct.
Hill, Clarke & Co., Boston, Mass.
Kempsmith Mfg. Co., Milwaukee, Wis.
Le Blond Mach. Tool Co., R. K., Cincinnati, O.
Marshall & Huschart Mchry. Co., Chicago, Ill.
McCabe, J. J., New York.
Owen Mach. Tool Co., Springfield, Ohio.
Prentiss Tool & Supply Co., New York.
Whitney Mfg. Co., Hartford, Ct.

Milling Machines, Portable

Underwood & Co., H. B., Philadelphia, Pa.

Milling Machines, Universal

American Tool Wks. Co., Cin., O.
Aurora Tool Works, Aurora, Ind.
Becker-Brainard Milling Mach. Co., Hyde Park, Mass.
Bement, Miles & Co., New York.
Brown & Sharpe Mfg. Co., Providence, R. I.
Cincinnati Milling Mach. Co., Cincinnati, O.
Fairbanks Co., New York.
Garvin Mach. Co., New York.
Hendey Mach. Co., Torrington, Ct.
Hill, Clarke & Co., Boston, Mass.
Kempsmith Mfg. Co., Milwaukee, Wis.
Le Blond Mach. Tool Co., R. K., Cincinnati, O.
Marshall & Huschart Mchry. Co., Chicago, ...
McCabe, J. J., New York.
Niles Tool Works Co., New York.
Owen Mach. Tool Co., Springfield, Ohio.
Prentiss Tool & Supply Co., New York.
Waltham Watch Tool Co., Springfield, Mass.

Milling Machines, Vertical

Becker-Brainard Milling Mach. Co., Hyde Park, Mass.
Bement, Miles & Co., New York.
Brown & Sharpe Mfg. Co., Providence, R. I.
Garvin Mach. Co., New York.
Ingersoll Mill. Mach. Co., Rockford, Ill.
Newton Mch. Tool Works, Philadelphia, Pa.
Niles Tool Works Co., New York.
Owen Mach. Tool Co., Springfield, Ohio.
Pratt & Whitney Co., Hartford, Conn.
Quint, A. D., Hartford, Conn.

Milling Tools, Adjustable

Geometric Drill Co., New Haven, Conn.
Rogers, Boat, Gage & Drill Wks., John M., Gloucester City, N. J.

Molding Machines

Adams Co., The, Dubuque, Iowa.
American Foundry & Mach. Co., Hanover, Pa.
Tabor Mfg. Co., Philadelphia, Pa.
Webster & Perks Tool Co., Springfield, O.

Motors, Electric

C & C Electric Co., New York.
Christensen Engr. Co., Milwaukee, Wis.
Commercial Electric Co., Indianapolis, Ind.
Crocker-Wheeler Co., Ampere, N.J.
Eck Dynamo & Motor Wks., Belleville, N. J.
General Electric Co., New York.
Jantz & Leist Elec. Co., Cin., O.
Mechanical Appliance Co., Milwaukee, Wis.
Milwaukee Elec. Co., Milwaukee, Wis.
Northern Elec. Mfg. Co., Madison, Wis.
Robbins & Myers Co., Springfield, Ohio.
Roth Bros. & Co., Chicago, Ill.
Sprague Electric Co., New York.
Storey Motor & Electric Co., Harrison, N. J.
Stow Mfg. Co., Binghamton, N. Y.
Triumph Elec. Co., Cincinnati, O.
Western Electric Co., Chicago, Ill.
Westinghouse Elec. & Mfg. Co., Pittsburgh, Pa.

Name Plates

Becker Name Plate Co., August, Boston, Mass.
Franklin Mfg. Co., Syracuse, N. Y.
G. & P. Engraving Co., Boston, Mass.
Murdock Corporation, Boston, Mass.
Turner Brass Works, Chicago, Ill.

Nut Tappers

See Bolt and Nut Machinery.

Oil Cups and Covers

Bay State Stamping Works, Worcester, Mass.
Besly & Co., Chas. H., Chicago, Ill.
Bowen Mfg. Co., Auburn, N. Y.
Bown Machine Works, Battle Creek, Mich.
Crane Co., Chicago, Ill.
Lunkenheimer Co., Cincinnati, O.
Tucker, W. W. & C. F., Hartford, Conn.
The Winkley Co., Hartford, Conn.

Oils

Besly & Co., Chas. H., Chicago, Ill.
Harris Oil Co., A. W., Provi., R. I.

Oils, Slushing

Harris Oil Co., A. W., Provi., R. I.

Oil Stones

Pike Mfg. Co., Pike Station, N. H.

Packing, Steam Joint

Jenkins Bros., New York.
N. Y. Belting & Packing Co., New York.
Peerless Rubber Mfg. Co., New York.

Paint, Machinery

Felton, Sibley & Co., Phila., Pa.
U. S. Gutta Percha Paint Co., Providence, R. I.

Pans, Lathe

Lyon Metallic Mfg. Co., Chicago, Ill.
New Britain Mch. Co., New Britain, Conn.

Pans, Shop

Lyon Metallic Mfg. Co., Chicago, Ill.

Patents

Baldwin, Davidson & Wight, Washington, D. C.
Howson & Howson, Phila., Pa.
Straley, Hasbrouck & Schloeder, New York.

Pattern Shop Machinery

American Mchry. Co., Grand Rapids, Mich.
Baker Bros., Toledo, O.
Brown & Zortman Mchry. Co., Pittsburg, Pa.
Fairbanks Co., New York.
Fay & Scott, Dexter, Me.
Greaves, Klusman & Co., Cin., O.
Marston & Co., J. M., Boston, Mass.
Prentiss Tool & Supply Co., New York.
Washburn Shops, Worcester, Mass.

Patterns, Wood

Olmstead Co., H. B., New York.

Pencils

Keuffel & Esser Co., New York.

Phosphor Bronze

Phosphor Bronze Smelting Co., Philadelphia, Pa.

Pinion Cutters

Loop-Lock Mach. Co., Waltham, Mass.

Pipe and Fittings

Crane Co., Chicago, Ill.

Pipe Cutting and Threading Machines

Bignall & Keeler Mfg. Co., Edwardsville, Ill.
Curtis & Curtis Co., Bridgeport, Conn.
Merrell Mfg. Co., Toledo, O.
Reed Mfg. Co., Erie, Pa.
Saunders' Sons, D., Yonkers, N. Y.
Wells Bros. Co., Greenfield, Mass.
Williams Tool Co., Erie, Pa.

Pipe Fitters' Tools

Cleveland Twist Drill Co., Cleveland, O.
Saunders' Sons, D., Yonkers, N. Y.
Standard Tool Co., Cleveland, O.

Planers

Affleck, Geo. E., New York.
American Tool Wks. Co., Cin., O.
Pelmer Mach. Tool Co., Cin., O.
Bement, Miles & Co., New York.
Betts Mach. Co., Wilmington, Del.
Cincinnati Planer Co., Cincin., O.
Detrick & Harvey Mch. Co., Baltimore, Md.
Fairbanks Co., New York.
Flather Planer Co., Mark, Nashua, N. H.
Garvin Mach. Co., New York.
Gray Co., G. A., Cincinnati, O.
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Hendey Mach. Co., Torrington, Ct.
Hill, Clarke & Co., Boston, Mass.
McCabe, J. J., New York.
Niles Tool Works Co., New York.
New Haven Mfg. Co., New Haven, Conn.
Pond Mach. Tool Co., New York.
Prentiss Tool & Supply Co., New York.
Sellers & Co., Wm., Phila., Pa.
Whitcomb Mfg. Co., Worcester, Mass.
Woodward & Powell Planer Co., Worcester, Mass.

Planers, Bench

Bartlett, E. E., Boston, Mass.

Planers, Portable

Morton Mfg. Co., Muskegon Heights, Mich.
Underwood & Co., H. B., Philadelphia, Pa.

Planers, Rotary

Bement, Miles & Co., New York.
Cleveland Punch & Shear Works, Cleveland, O.
Newton Mach. Tool Wks., Philadelphia, Pa.
Pond Mach. Tool Co., New York.
Underwood & Co., H. B., Philadelphia, Pa.

Presses, Hand

Elwes Engr. Works, Chas. F., Chicago, Ill.
Perkins Mach. Co., So. Boston, Mass.

Presses, Hydraulic

Elmes Engr. Works, Chas. F., Chicago, Ill.
Watson-Stillman Co., New York.

Presses, Power

Automatic Mach. Co., Bridgeport, Conn.
Bethlehem Fdry. & Mch. Co., So. Bethlehem, Pa.
Bliss Co., E. W., Brooklyn, N. Y.
Chambersburg Engr. Co., Chambersburg, Pa.
Dellvouk & George, Chicago, Ill.
Fairbanks Co., New York.
Falkenau-Sinclair Co., Phila., Pa.
Mossberg & Granville Mfg. Co., Providence, R. I.
Perkins Mach. Co., So. Boston, Mass.
Prentiss Tool & Supply Co., New York.

Profilers

Garvin Mach. Co., New York.
Pratt & Whitney Co., Hartford, Conn.

Pulleys

American Pulley Co., Phila., Pa.
Caldwell & Son Co., H. W., Chicago, Ill.
Cresson Co., Geo. V., Phila., Pa.
Federal Mfg. Co., Cleveland, O.
Howard Iron Wks., Buffalo, N. Y.

Pulleys—*Continued*

Oneida Steel Pulley Co., Oneida, N. Y.
Patterson, Gottfried & Hunter, Ltd., New York.
Reeves Pulley Co., Columbus, Ind.
The Xylotite Co., Cincinnati, O.

Pulleys, Friction Cone

Evans Friction Cone Co., Boston, Mass.

Pulleys, Speed Changing

Speed Changing Pulley Co., Indianapolis, Ind.

Pulley Turning and Boring Machines

Harrington, Son & Co., Edwin, Philadelphia, Pa.
New Haven Mfg. Co., New Haven, Conn.
Niles Tool Works Co., New York.
Streit Mach. Co., A., Cincin., O.

Pumps, Hydraulic

Elmes Engr. Works, Chas. F., Chicago, Ill.
Watson-Stillman Co., New York.

Punches, Hydraulic

Bement, Miles & Co., New York.
Bethlehem Fdry. & Mch. Co., So. Bethlehem, Pa.
Watson-Stillman Co., New York.

Punches, Power

Bliss Co., E. W., Brooklyn, N. Y.
Bremer Mach. & Tool Co., Kalamazoo, Mich.
Buffalo Forge Co., Buffalo, N. Y.
Cincinnati Punch & Shear Co., Cincinnati, O.
Cleveland Punch & Shear Wks. Co., Cleveland, O.
Hilles & Jones Co., Wilmington, Del.
Long & Allstatter Co., Hamilton, Ohio.
Perkins Mach. Co., S. Boston, Mass.
Williams, White & Co., Moline, Ill.

Rack Cutting Machines

Fellows Gear Shaper Co., Springfield, Vt.
Le Blond Mach. Tool Co., R. K., Cincinnati, O.
Reed Co., F. E., Worcester, Mass.
Walcott & Son, Geo. D., Jackson, Mich.

Racks, Cut

Fellows Gear Shaper Co., Springfield, Vt.
Nuttall Co., R. D., Pittsburgh, Pa.
Simonds Mfg. Co., Pittsburgh, Pa.
Standard Gauge Steel Co., Beaver Falls, Pa.
Walcott & Son, Geo. D., Jackson, Mich.

Racks, Tool

Lyon Metallic Mfg. Co., Chicago, Ill.
New Britain Mach. Co., New Britain, Conn.

Reamers

Chadwick & Co., G. B., Portsmouth, N. H.
Cleveland Twist Drill Co., Cleveland, O.
Clough, R. M., Tolland, Conn.
McCrosky, F. B., Cincinnati, O.
Morse Twist Drill & Mach. Co., New Bedford, Mass.
New Process Twist Drill Co., Taunton, Mass.
Pratt & Whitney Co., Hartford, Conn.
Rogers, John M., Boat, Gage & Drill Works, Gloucester City, N. J.
Standard Tool Co., Cleveland, O.
Wells Bros. Co., Greenfield, Mass.

Reaming Stands

Flather Planer Co., Mark, Nashua, N. H.

Rheostats

Cutler-Hammer Mfg. Co., Milwaukee, Wis.

Riveters, Pneumatic

Bement, Miles & Co., New York.
Cleveland Pneumatic Tool Co., Cleveland, O.
Philadelphia Pneumatic Tool Co., Philadelphia, Pa.
Railway Appliances Co., Chicago, Ill.
Rand Drill Co., New York.
Standard Ry. Equip. Co., St. Louis, Mo.

Riveters, Hydraulic

Bement, Miles & Co., New York.
Watson-Stillman Co., New York.

Riveting Machines

Bement, Miles & Co., New York.
Bethlehem Foundry & Mach. Co., So. Bethlehem, Pa.
Chambersburg Engr. Co., Chambersburg, Pa.
Long & Allstatter Co., Hamilton, Ohio.
Perkins Mach. Co., So. Boston, Mass.

Rods, Connecting

American Mchry. & Export Co., New York.

Roller and Ball Bearings

American Roller Bearing Co., Boston, Mass.
Ball Bearing Co., Philadel., Pa.
Bantam Mfg. Co., Bantam, Conn.
Mossberg & Granville Mfg. Co., Providence, R. I.
Standard Roller Bearing Co., Philadelphia, Pa.

Rolling Mill Machinery

Cleveland Punch & Shear Wks. Co., Cleveland, O.
Hilles & Jones Co., Wilmington, Del.
Mossberg & Granville Mfg. Co., Providence, R. I.
Pratt & Whitney Co., Hartford, Conn.

Rubber Goods, Mechanical

N. Y. Belting & Packing Co., New York.
Peerless Rubber Mfg. Co., New York.

Rules, Steel

Mass. Tool Co., Greenfield, Mass.
Sawyer Tool Co., Fitchburg, Mass.
Slocomb Co., J. T., Provi., R. I.

Safety Valves, Pop

Crane Co., Chicago, Ill.
Crosby Steam Gage & Valve Co., Boston, Mass.
Lunkenheimer Co., Cincinnati, O.

Sand Blast Apparatus

Paxson Co., J. W., Philadel., Pa.

Sand Mixing Machines

Hanna, E. E., Chicago, Ill.
Obermayer Co., S., Cincinnati, O.
Smith Fdry. Supply Co., J. D., Cleveland, O.

Sawing Machines, Metal

Cleveland Punch & Shear Works Co., Cleveland, O.
Cochrane-Bly Mach. Works, Rochester, N. Y.
Newton Mach. Tool Works, Philadelphia, Pa.
Pratt & Whitney Co., Hartford, Conn.
Resek Mach. Tool Co., Cleveland, Ohio.
West Haven Mfg. Co., New Haven, Conn.

Sawing Machines, Wood

Brown & Zortman Mchry. Co., Pittsburg, Pa.
Marston & Co., J. M., Boston, Mass.

Schools, Correspondence

Amer. School of Correspondence, Chicago, Ill.
Consolidated Schools, N. Y. City.
International Correspond. Schools, Scranton, Pa.

Schools, Technical

Mich. College of Mines, Houghton, Mich.
State College of Ky., Lexington, Ky.

Screw Machines, Hand

Brown & Sharpe Mfg. Co., Providence, R. I.
Cleveland Automatic Mach. Co., Cleveland, O.
Draper Mach. Tool Co., Worcester, Mass.
Garvin Mach. Co., New York.
Jones & Lamson Mch. Co., Springfield, Vt.
Pearson Mach. Co., Chicago, Ill.
Potter & Johnston Mach. Co., Pawtucket, R. I.
Pratt & Whitney Co., Hartford, Conn.
Warner & Swasey Co., Cleveland, Ohio.
Windsor Mach. Co., Windsor, Vt.

Screw Machines, Automatic
Brown & Sharpe Mfg. Co., Providence, R. I.
Cleveland Automatic Mach. Co., Cleveland, O.
Dreses Mach. Tool Co., Cincin., O.
Marshall & Huschart Mchry. Co., Chicago, Ill.
Windsor Mach. Co., Windsor, Vt.

Screw Machinery, Wood and Lag
Baker Bros., Toledo, Ohio.
Cook Co., Asa S., Hartford, Conn.

Screw Plates
Bay State Tap & Die Co., Mansfield, Mass.
Besly & Co., Chas. H., Chicago, Ill.
Carpenter Tap & Die Co., J. M., Pawtucket, R. I.
Card Mfg. Co., S. W., Mansfield, Mass.
Hart Mfg. Co., Cleveland, O.
Morse Twist Drill & Mach. Co., New Bedford, Mass.
Wells Bros. Co., Greenfield, Mass.
Wiley & Russell Mfg. Co., Greenfield, Mass.

Second Hand Machinery
Affleck, Geo. E., New York.
Baird Machy. Co., Pittsburg, Pa.
Bowler & Co., Geo. H., Cleveland, Ohio.
Brown & Zortman Mchry. Co., Pittsburgh, Pa.
Carlin Mchry. & Supply Co., Allegheny, Pa.
Fairbanks Co., New York.
Fairbanks Co., Philadelphia, Pa.
Garvin Mch. Co., New York.
Hill, Clarke & Co., Boston, Mass.
Marshall & Huschart Mchry. Co., Chicago, Ill.
McCabe, J. J., New York.
Niles-Bement-Pond Co. New York.
Packard Machinery Co., O. L., Chicago, Ill.
Pratt & Whitney Co., Hartford, Conn.
Prentiss Tool & Supply Co., New York.
Toomey, Frank, Philadelphia, Pa.
Wickes Bros., New York.
Wormer Machy. Co., C. C., Detroit, Mich.

Separators, Magnetic
Sawyer, Ezra, Worcester, Mass.

Separators, Oil
National Separator & Mch. Co., Manchester, N. H.

Shapers
American Tool Wks. Co., Cin., O.
Barker & Co., Wm., Cincinnati, O.
Bement, Miles & Co., New York.
Blount & Co., J. G., Everett, Mass.
Cincinnati Shaper Co., Cincin., O.
Fairbanks Co., New York.
Flather Planer Co., Mark, Nashua, N. H.
Garvin Mach. Co., New York.
Gould & Eberhardt, Newark, N. J.
Hendey Mch. Co., Torrington, Ct.
Hill, Clarke & Co., Boston, Mass.
Kelly Co., R. A., Xenia, Ohio.
Marshall & Huschart Mchry. Co., Chicago, Ill.
Morton Mfg. Co., Muskegon Heights, Mich.
New Haven Mfg. Co., New Haven, Conn.
Niles Tool Works Co., New York.
Perkins Mach. Co., So. Boston, Mass.
Potter & Johnston Mach. Co., Pawtucket, R. I.
Prentiss Tool & Supply Co., New York.
Smith & Mills, Cincinnati, O.
Steptoe Shaper Co., John, Cincinnati, O.
Walcott & Son, Geo. D., Jackson, Mich.

Shears, Power
Bethlehem Fdry. & Mch. Co., So. Bethlehem, Pa.
Bliss Co., E. W., Brooklyn, N. Y.
Bremer Mach. & Tool Co., Kalamazoo, Mich.
Buffalo Forge Co., Buffalo, N. Y.
Cincinnati Punch & Shear Co., Cincinnati, O.
Cleveland Punch & Shear Works, Cleveland, O.
Falkenau-Sinclair Co., Phila., Pa.
Hilles & Jones Co., Wilmington, Del.
Long & Allstatter Co., Hamilton, Ohio.
Perkins Mach. Co., So. Boston, Mass.
Williams, White & Co., Moline, Ill.

Shears, Rotary
Bethlehem Foundry & Mach. Co., So. Bethlehem, Pa.
Detrick & Harvey Mach. Co., Baltimore, Md.
Perkins Mach. Co., So. Boston, Mass.

Shelving, Shop
New Britain Mach. Co., New Britain, Conn.

Slide Rests
Reed Co., F. E., Worcester, Mass.
Rhodes, L. E., Hartford, Conn.

Slotters
Baker Bros., Toledo, Ohio.
Barr, H. G., Worcester, Mass.
Bement, Miles & Co., New York.
Betts Mach. Co., Wilmington, Del.
Garvin Mach. Co., New York.
New Haven Mfg. Co., New Haven, Conn.
Newton Mach. Tool Wks., Philadelphia, Pa.
Niles Tool Works Co., New York.

Sockets and Sleeves
New Process Twist Drill Co., Taunton, Mass.

Springs
Dunbar Bros., Bristol, Conn.

Sprocket Chains
See Driving Chains.

Stampings, Sheet Steel
Federal Mfg. Co., Cleveland, O.

Stamps, Steel
Schwerdtle Stamp Co., Bridgeport, Conn.

Steel, Machinery
Boker & Co., Hermann, New York.
Patriarche & Bell, New York.
Ward & Son, Edgar T., Boston, Mass.

Steel, Sheet
Federal Mfg. Co., Cleveland, O.
Ward & Son, Edgar T., Boston, Mass.

Steel, Tool
Boker & Co., Hermann, New York.
Firth-Sterling Steel Co., Demmler, Pa.
Patriarche & Bell, New York.
Patterson, Gottfried & Hunter, Ltd., New York.
Westmoreland Steel Co., Pittsburg, Pa.

Stones, Oil
Pike Mfg. Co., Pike Station, N. H.

Straightener, Hydraulic
Bement, Miles & Co., New York.
Watson-Stillman Co., New York.

Swaging Machines
Excelsior Needle Co., Torrington, Conn.
Mossberg & Granville Mfg. Co., Providence, R. I.

Switchboards
C & C Electric Co., New York.
Triumph Elec. Co., Cincinnati, O.
Western Electric Co., Chicago, Ill.
Westinghouse Elec. & Mfg. Co., Pittsburg, Pa.

Tapping Machines and Attachments
Baker Bros., Toledo, O.
The Beaman & Smith Co., Providence, R. I.
Bickford Drill & Tool Co., Cin., O.
Cincinnati Mach. Tool Co., Cincinnati, O.
Errington, F. A., N. Y. City.
Fosdick Mach. Tool Co., Cin., O.
Garvin Mach. Co., New York.
Geometric Drill Co., New Haven, Conn.
Modern Too' Co., Erie, Pa.
Pratt & Whitney Co., Hartford, Conn.
Quint, A. D., Hartford, Conn.
Webster & Perks Tool Co., Springfield, O.
Whitney Mfg. Co., Hartford, Conn.
Woodward & Rogers Co., Hartford, Conn.

Taps, Collapsing
Geometric Drill Co., New Haven, Conn.

Taps and Dies
Bay State Tap & Die Co., Mansfield, Mass.
Besly & Co., Chas. H., Chicago, Ill.
Card Mfg. Co., S. W., Mansfield, Mass.
Carpenter Tap & Die Co., J. M., Pawtucket, R. I.
Cleveland Twist Drill Co., Cleveland, O.
Crane Co., Chicago, Ill.
Geometric Drill Co., New Haven, Conn.
Hammacher, Schlemmer & Co., New York.
Hardinge Bros., Chicago, Ill.
Hart Mfg. Co., Cleveland, O.
Morse Twist Drill & Mach. Co., New Bedford, Mass.
Patterson, Gottfried & Hunter, Ltd., New York.
Pratt & Whitney Co., Hartford, Conn.
Standard Tool Co., Cleveland, O.
Webster & Perks Tool Co., Springfield, O.
Wells Bros. Co., Greenfield, Mass.
Wiley & Russell Mfg. Co., Greenfield, Mass.

Telephone System
Clark Auto. Telephone Switch Board Co., Providence, R. I.

Thread Cutting Tools
Besly & Co., Chas. H., Chicago, Ill.
Hart Mfg. Co., Cleveland, O.
Pratt & Whitney Co., Hartford, Conn.
Rivett-Dock Co., Boston, Mass.

Tongs, Machinery
Acme Tongs Co., Chicago, Ill.

Tool Holders
Armstrong Bros. Tool Co., Chicago, Ill.
Hill Tool Co., Anderson, Ind.
Hoggson & Pettis Mfg. Co., New Haven, Conn.
McCrosky, F. B., Cincinnati, O.
O. K. Tool Holder Co., Shelton, Conn.
Western Mfg. Co., Springfield, O.

Tools, Small
See Machinists' Small Tools.

Tracing Cloth
Keuffel & Esser Co., New York.
Hardtmuth, L. & C., New York.

Transmission Machinery
American Pulley Co., Phila., Pa.
Caldwell & Son Co., H. W., Chicago, Ill.
Case Mfg. Co., Columbus, O.
Cresson & Co., Geo. V., Phila., Pa.
Federal Mfg. Co., Cleveland, O.
Link-Belt Engineering Co., Philadelphia, Pa.
National Machine Tool Co., Cincinnati, O.
Oneida Steel Pulley Co., Oneida, N. Y.
Patterson, Gottfried & Hunter, Ltd., New York.
Power & Speed Regulator Mfg. Co., Kalamazoo, Mich.
Reeves Pulley Co., Columbus, Ind.

Trimmers, Wood
American Mchry. Co., Grand Rapids, Mich.
Washburn Shops, Worcester, Mass.

Trolleys and Tramways
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Hunt Co., C. W., West New Brighton, N. Y.
Link Belt Engineering Co., Philadelphia, Pa.
Maris Bros., Philadelphia, Pa.
Yale & Towne Mfg. Co., New York.

Tubing, Steel
Shelby Steel Tube Co., Pittsburgh, Pa.

Turret Machines
Automatic Mach. Co., Greenfield, Mass.
Bradford Mach. Tool Co., Cincinnati, O.
Brown & Sharpe Mfg. Co., Providence, R. I.
Bullard Mach. Tool Co., Bridgeport, Conn.
Dreses Mach. Tool Co., Cincin., O.
Flather & Co., Nashua, N. H.
Garvin Mach. Co., New York.
Gisholt Mch. Co., Madison, Wis.
Hill, Clarke & Co., Boston, Mass.
Jones & Lamson Mch. Co., Springfield, Vt.

Turret Machines—*Continued*
Le Blond Mach. Tool Co., R. K., Cincinnati, O.
Lodge & Shipley Mach. Tool Co., Cincinnati, O.
Milwaukee Mach. Tool Co., Milwaukee, Wis.
Niles Tool Works Co., New York.
Pearson Mach. Co., Chicago, Ill.
Potter & Johnston Mach. Co., Pawtucket, R. I.
Warner & Swasey Co., Cleveland, Ohio.
Windsor Mach. Co., Windsor, Vt.

Turrets, Carriage
Fay & Scott, Dexter, Me.

Twist Drills
Cleveland Twist Drill Co., Cleveland, O.
Hammacher, Schlemmer & Co., New York.
Morse Twist Drill & M. Co., New Bedford, Mass.
New Process Twist Drill Co., Taunton, Mass.
Patterson, Gottfried & Hunter, Ltd., New York.
Standard Tool Co., Cleveland, O.

Unions, Brass
Nolte Brass Co., Springfield, O.

Universal Joints
Baush Machine Tool Co., Springfield, Mass.
Vanderbeek Tool Wks., Hartford, Conn.

Valves
See Steam Fittings.

Vises, Drill
Graham Mfg. Co., Provi., R. I.
Hollands Mfg. Co., Erie, Pa.
Hopkinson Mach. Works, Springfield, Mass.
Jacobson Mach. Mfg. Co., Warren, Pa.

Vises, Metal Workers'
Hammacher, Schlemmer & Co., New York.
Hanna, E. E., Chicago, Ill.
Howard Iron Wks., Buffalo, N. Y.
Jacobson Mach. Mfg. Co., Warren, Pa.
Parker Co., Chas., Meriden, Conn.
Reed Mfg. Co., Erie, Pa.
Standard Tool Co., Athol, Mass.
Walworth Mfg. Co., Boston, Mass.

Vises, Pipe
Curtis & Curtis Co., Bridgeport, Conn.
Saunders' Sons, D., Yonkers, N. Y.
Walworth Mfg. Co., Boston, Mass.

Vises, Planer and Shaper
Cincinnati Planer Co., Cincin., O.
Hendey Mach. Co., Torrington, Ct.
Pratt & Whitney Co., Hartford, Conn.

Vises, Wood Workers'
Gard, J. L., Denver, Colo.
Hammacher, Schlemmer & Co., New York.
Wyman & Gordon, Worcester, Mass.

Welding, Electric
Standard Welding Co., Cleve., O.

Welding Machines
Long & Allstatter Co., Hamilton, Ohio.

Wire-Drawing Machinery
Iroquois Mach. Co., New York.
Mossberg & Granville Mfg. Co., Providence, R. I.

Wire-Forming Machinery
Automatic Mach. Co., Bridgeport, Conn.

Wire-Straightening Machinery
Hoefer Mfg. Co., Freeport, Ill.

Worm Hobbing Machines
Pratt & Whitney Co., Hartford, Conn.

Worm Milling Machines
Cleveland Automatic Mach. Co., Cleveland, O.
Pratt & Whitney Co., Hartford, Conn.

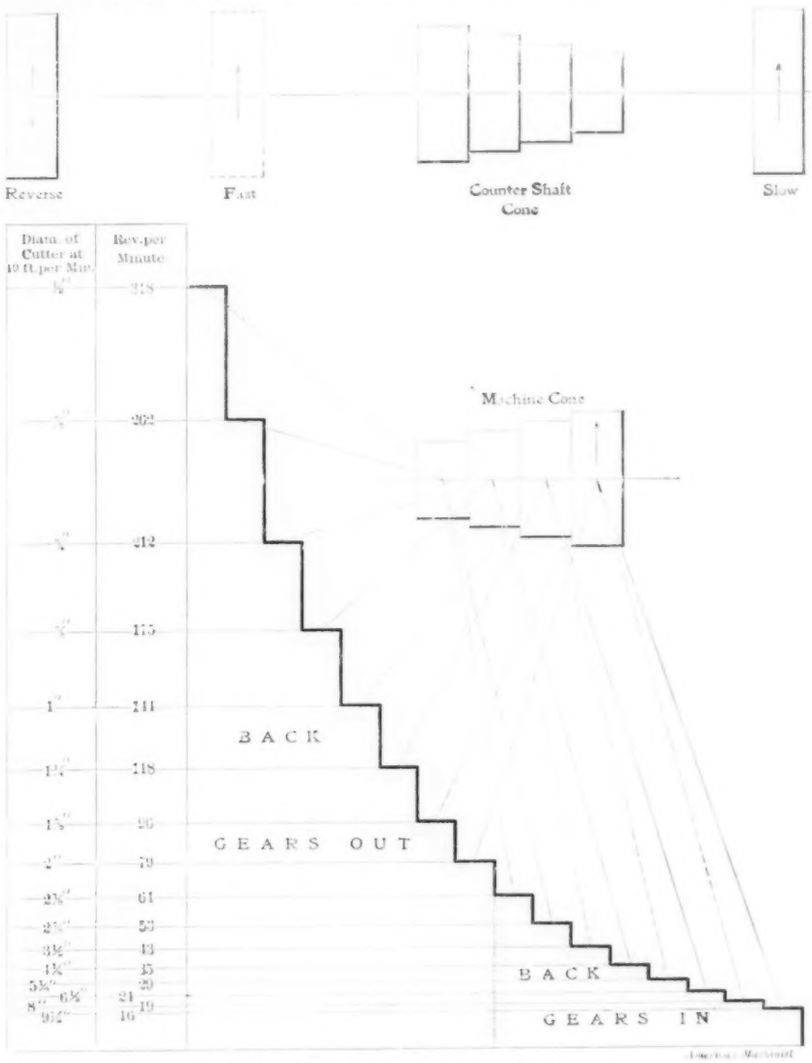
Wrenches
Coes Wrench Co., Worcester, Mass.
Standard Tool Co., Athol, Mass.

Wrenches, Drop Forged
Billings & Spencer Co., Hartford, Conn.

Speed Diagram for the Brown & Sharpe Universal Milling Machine.

For the accompanying diagram we are indebted to the Brown & Sharpe Manufacturing Company, by whom it has been prepared to show the speeds and suitable diameters of cutters for their No. 2 universal milling machine. The full radial lines from the machine cone pulley give the speeds obtained with the slow countershaft pulley, while the dotted lines give the speeds due to the fast countershaft pulley.

Incidentally the diagram shows how



SPEED DIAGRAM FOR MILLING MACHINES.

uniform is the progression of speeds in this machine, and it also shows the appropriateness of a geometrical progression of speeds to machine tool work. Between the slowest two speeds there is a difference of only three revolutions per minute, while between the fastest two the difference is fifty-six. Nevertheless, the difference in the appropriate diameter of cutters at the slowest speeds is 1½ inches, while at the highest it is only ⅛ inch. Relatively the differences of diameter have about the same importance in both cases, and were the diameters figured exactly instead of to the nearest eighth of an inch, the differences would have almost exactly the same importance.

The Metric System in the Machine Shop.

August Hoffmann is a young man born in America, but of German extraction, and for several years was with Hugo Bilgram, of Philadelphia. At Chicago he had charge of Mr. Bilgram's exceptionally interesting exhibit. About six years ago J. E. Reinecker, of Chemnitz, Germany, took up Mr. Bilgram's machine and the manufacture of gears by the use of it, and Mr. Hoffmann was selected to go over to Chemnitz and have charge of this work. Knowing that he had been trained in inch measurements and had now had some years' experience with the metric system, we asked him for his views as to the relative merits of the systems for shop use. In reply he writes as follows:

"It makes no difference to the man who works on the lathe, drill press, milling machine, etc., what system he is working to, either metric or English, or for that matter it can be called Bill, Mike or Harry; it is the same to him. He is working to gages and these gages are made to sizes according to the usage of the shop, and the man cares little about the name by which the system is called. I may just mention a case in point. I am building the automatic bevel gear planers of different types from Mr. Bilgram's patents, of which my firm, Messrs. Reinecker, holds the rights. All measurements are in English, but it made no difference to the men under me; they were supplied with English gages, scales, jigs, etc., and work went along without a single hitch. When the first machine was finished I found it to be built very accurately; in fact if I had built it to my metric gages it could not have been better built. None of my men has ever worked to 32nds, 16ths, 8ths of inches, etc. to such a large extent as now, but it does not interfere with their speed when they only have their gages to work by. I have built seven complete machines all in English, and found no trouble whatever.

"Now from the designer's or constructor's standpoint I can assure you that there is nothing so simple for him as the metric system of measures and weights. He has his hundredth, tenth, millimeter, all in one, which is quicker to calculate when having a quantity of figures to sum up than having 6 feet 9 inches 7-32nds, which must always be taken into fractions and ofttimes will not sum up. As I have now nearly six years of experience behind me I say it would be utter folly for me to say the English system is the best, as I have to do with both in the future and my view is that the metric system is the best for the designer, and those who have to use their brains in the drawing office; but for the men working the machines, gages will suffice for all their wants.

"I could go more deeply into the question from the designer's standpoint, and could prove to the satisfaction of anyone that the metric system quickens work and is much simpler to rectify if a mistake has been found on a drawing than is our English system; although I work to both I prefer the metric decimal system. There is one point I wish to bring before your readers, and that is the English decimal system of 0.001 inch. Why has the inch been given and changed into decimals? Because the 64th was not fine enough, whereas in the metric system you have only millimeters, tenths and hundredths all through to work from. All I can say is that, if those who have not made use of the metric system will do so, they will soon agree it is a brain saver to those who calculate.

"I trust my testimony may help to swell the votes that shall hasten the adoption of the metric system, as it will, I believe, be for the universal good and the welfare of our country."

In a later letter from Mr. Hoffmann he states that, having built the first machines to the English system because the drawings were so made and because he had

at hand the necessary gages and graduated rules made to that system, he afterwards made some additional machines to the metric system. In doing so he made as few and as small changes as possible, knowing that the first machines were all right and being anxious to avoid the liability of possible trouble caused by changes. He therefore took, in most cases, the nearest metric equivalent that could be expressed in whole numbers. As to the time required, he writes: "Comparing the time between the English and the metric built machines it is astonishing to note how much less time it took to build the metric than the English machines, although we work to both systems." So it would seem from this later experience that Mr. Hoffmann concludes that it does make a difference to the workman as to which system he uses. Some of the saving in time is no doubt due, however, to the fact that the men had, in the building of the first machines, that experience which always facilitates the construction of later ones. Mr. Hoffmann says, however, that he finds the men who are doing the work are glad to be back to the use of the metric system, and if they are glad it can mean only that the metric system gives them less trouble, and that they work by it with greater facility.

The Premium Plan in England.

We have been favored with an advance copy of a paper entitled "The Premium System of Remunerating Labor," which was read at the April 4 meeting of the Manchester Association of Engineers by Mr. John Ashford. Like numerous other papers and articles upon the subject which have appeared in England, this one illustrates primarily the interest which is shown there in the system. It is notable also that this paper, like many of the others, emphasizes the necessity of a rate-fixing or time-setting department as a starting point, whereas in this country the necessity for such a department is not felt in most shops. By the rate-fixing department is meant a department in which results are collected and analyzed, the data thus obtained being applied to the setting of time rates on work which has not been done before. This is a class of work to which the system has been applied but little in this country, its application here being chiefly to manufactured or repetition work in which the time allowances are obtained by simply consulting the records, and the emphasis which is laid upon the rate-fixing department in Great Britain and the absence of it here are, no doubt, due to this fact. It also points out, however, the fact that the system has been extensively applied in Great Britain to a class of work to which the application here is almost wanting. In this there is, we are satisfied, much for Americans to learn from British experience. A leading application of the system there is to the construction of marine engines in which, as a matter of course, manufacturing is impossible. One of the first firms in Great Britain to take up the use of the system was David Rowan & Co., of Glasgow, whose business is the construction of marine engines, and in this line of work they apply the system to all departments, including erecting. It was, perhaps, from the fact that the system was early applied there to this class of work and to the further fact that Mr. James Rowan has been quite active in publishing the results that have been obtained, that extended application under similar conditions has followed. It so happens, however, that in previous papers that we have seen but little explanation has been given of this characteristic feature of British use of the system. The present paper gives in considerable detail the methods followed by the author, and indicates, as other papers have done, the thorough manner in which the subject has been attacked in Great Britain. We could, however, wish for still further information regarding the methods of rate fixing used there, especially the methods of analyzing the facts and reducing them to fundamental data and then the application of these data to new cases as they arise. It is, we judge, chiefly a matter of area of surface to be machined, character of finish and fit, degree of accuracy, material to be worked and nature of the operation—that is, whether turning, drilling, planing or milling. To state the problem in this general way is to indicate its magnitude and complexity, and it is

Machine No. 104. *Sheet No. 1,134.*
Job No. 12—Crankshaft.
Catalog No. 041. Drawing No. 5,560. Date 23/12/02.

Turning (previously roughed on body).

Process.	Tool	Feed.	Speed.	Cut	Finish.	Time.	Remarks
1 Centering and setting up						4.0	
2 Turning ends for throws		8	A 2			2.0	
3 Lifting out and sett'g up throws						2.45	
4 Balancing, etc.						3.15	
5 Roughing H P. pins and webs		8 & 16	B & A2	5/16		5.30	
6 Finishing do.		8 & 16	D 2		No. 1	3.0	
7 Radiusing do.		Hand	B 2			1.15	
8 Filing out oval and lapping					No. 1	5.0	
9 Change centers to L.P. pin						2.0	
10 Roughing L.P. pins and webs		8 & 16	B & A2			5.30	
11 Finishing do.		8 & 16	D 2			3.0	
12 Radiusing		Hand	B 2			1.15	
13 Filing out oval and lapping					No. 1	5.0	
14 Changing centers to L.P. 2						2.0	
15 Roughing L.T. pins and webs		8 & 16	B & A2			5.30	
16 Finishing do.		6 & 16	D 2			3.0	
17 Radiusing do.		Hand	B 2			1.15	
18 Filing out oval and lapping					No. 1	5.0	
19 Changing centers to webs H.P.						2.0	
20 Roughing H P. webs		8	A 2			1.0	
21 Finishing		8	D 2		No. 5	1.0	
22 Repeat 19, 20, 21, twice						8.0	
23 Change centers to body						5.0	
24 Turning body rough		8	A 2			5.30	
25 Rough webs outside		16	A 2			4.0	
26 Reducing radii		Hand	A 2			2.0	
27 Finish body		8	C 2		No. 1	9.0	
28 do. webs outside		16	D 2		No. 5	6.0	
29 do. 8 radii		Hand	C 2			2.40	
30 File and lap body					No. 1	9.30	
31 Change for end						.45	
32 Rough do.			A 2			2.0	
33 Finish do.			A 2			1.0	
34 Lap do					No. 1	1.30	
35 Add for grinding, gaging, craning, etc.						13.30	
						145.40 Net time	
Add allowance							
If loose steel centers required, add for boring up, etc.						11.0	

Finishes.

No. 1.	Best, accurate to .001 in.	Time Fixer
No. 2.	Good, accurate to .002 in.	
No. 3.	Medium, accurate to .005 in.	
No. 4.	High Polish.	
No. 5.	Left broad cut or water.	
No. 6.	Rough Machine.	
No. 7.	Left .010 in. full for grinding.	
No. 8.	Left for forcing fit.	

TABLE I—SPECIMEN TIME SETTING SHEET.

obvious that there is here a large field for the comparison of methods and results.

Mr. Ashford gives his method of dealing with certain other phases of the subject about which questions have been raised here, but about which little has appeared in print, and we quote from his paper as follows:

Queries may be advanced as to how the premium system may be successfully worked in such comparative instances as where:

A. One man works one machine.

B. One man works two machines.

C. One man works three machines.

D. An apprentice boy works one machine.

E. An improver works one machine.

F. One man and one boy work two machines.

The author has met these several cases in what proves to be a satisfactory way, basing his reasoning upon the ideas that it is desirable, firstly, that, from the employers' point of view, one man should work several machines; secondly, that, from the workers' point of view, if he operates several machines, he shall have a sufficiently increased return as an inducement; and, thirdly, that a boy, inexperienced in the use of a machine, requires more time to get through a given piece of work.

Machine No. 1. *Sheet No. 859.*
Job—Distance, Piece.
Catalog No. 250. Drawing No. 4,154. Date 19/11/02.
Boring.

Process.	Tool.	Feed.	Speed.	Cut.	Finish.	Time.	Remarks.
1 Roughing 2 cuts		16	B 2		No. 6	156	
2 Finishing 1 cut		12	B 2		No. 1	52	
3 Face up		Hand				15	
4 Chamfer 2 places						30	
5 Bore for plate, 2 cuts						20	
6 do. finish					No. 3	10	
7 Recess for plate						40	
8 Handling						150	
						473 min. net = 8 hrs say.	
Add allowance for balance							

Finishes.

No. 1.	Best, accurate to .001 in.	Time Fixer
No. 2.	Good, accurate to .002 in.	
No. 3.	Medium, accurate to .005 in.	
No. 4.	High Polish.	
No. 5.	Left broad cut or water.	
No. 6.	Rough Machine.	
No. 7.	Left .010 in. full for grinding.	
No. 8.	Left for forcing fit.	

TABLE 2—SPECIMEN TIME SETTING SHEET.

Considering—

A. That one man working one machine is allowed an amount of time equal to unity..... 1

B. The time allowed for work on each of two machines shall be two-thirds that allowed in case A, giving a total for the two machines of..... 1⅓

(Note.—Where an operator works several machines his time is evenly divided when looking to the work on each machine. The extra one-third time allows a margin for the slight loss of time on each machine by divided attention, and leaves a margin for extra premium.)

C. The time allowance for each machine is, in this case, one-half that of case A, giving a total for the three machines of..... 1½

D. Instead of changing the time allowance for an apprentice, the case is met by charging to the job one-half of the time taken (half-time charged)..... 1

E. For an improver who is earning less than a sovereign a week, the time allowance remains constant, but the time taken is charged as three-fourths (three-quarter time charged)..... 1

F. To meet this case, the time is initially taken for each machine as in case A, and three-fourths of that is allowed, making a total for the two machines of..... 1½

(Note.—As an inducement to a man to partner with a boy in this manner, the boy charges his time at one-half, the same as an apprentice working one machine, and to obtain a suitable division of time, both the man and the boy book a half of their chargeable times to each machine.)

In the average establishment, certain degrees of accuracy must be obtained for the work to be satisfactory, and it is necessary to have some form of inspection to decide when a sufficiently high standard has been reached. The standard required should be made as clear and distinct as possible, and there should be but little opportunity

Vertical Boring Mills. *Sheet No. 7a.*

Machine No.	Description.	Capacity. Dia.	Capacity. Depth.	No. of Speeds on C. S.	Speeds (revs. per min.) Double Gear.				Speeds (revs. per min.) Single Gear.				Feeds (per inch)					Remarks.
155	Vertical Boring Mill double gear 4¼ to 1	Ft. In. 5 0	Ft. In. 3 6	1	1½	2¼ 5½	3	4	7	10 24	13½	18		2¾ 12	4 16	8 32		Gear feed.
	Vertical Boring Mill double gear 6 to 1	3 3	2 6	1	1¼	2½ 7½	3½	5	11	15½ 44	22	31	2 10	2½ 12	3 16	4 32	8	Gear feed.
122	Vertical Boring Mill double gear 16 to 1 and 4 to 1	4 0	1 10	2	1½ 1¾ 6 7	2 2½ 8½ 10	3 3½ 12 14	4 5 16 20	24 28	34 40	48 64	64 80	2¾ 12	4 14	5 16	8 32	10	Friction feed.
135	Vertical Boring Mill with turret, double gear 6 to 1	2 8	0 11	2	2¼ 3¾	4½ 6	7 9½	11 15	16 22	27 36	42 56	66 90	4 10 32	4½ 12 48	5 16	6 20	8 24	Friction feed.

TABLE 3—SPECIMEN SCHEDULE OF MACHINE TOOL DATA.

for the exercise of personal opinion as to whether the work is or is not passable. To establish a deciding line, it is generally advisable to have some form of limit-gage system of measurement, with the clear understanding that if the job fails to come within the limitations it may be scrapped, and upon scrap no premium is paid. This understanding may be supplemented by an arrangement to the effect, that, although a job is outside the allowed limitations, it may, by the expenditure of further time and money in other processes by way of correction, be made good enough, one-half premium only will be paid, the remaining half going towards the cost of making the job usable.

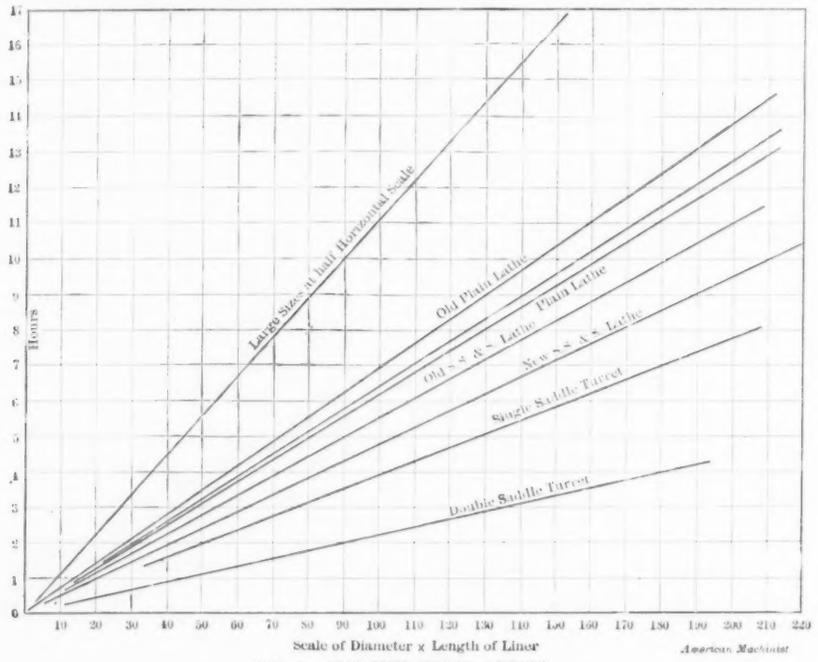

Hours
Large Sizes at half Horizontal Scale
Old Plain Lathe
Plain Lathe
Old 5 & 5 Lathe
New 5 & 5 Lathe
Single Saddle Turret
Double Saddle Turret
10 20 30 40 50 60 70 80 90 100 110 120 130 140 150 160 170 180 190 200 210 220
Scale of Diameter x Length of Liner
American Machinist

FIG. 1. TURNING VALVE LINERS.

In the event of material proving faulty to the extent of making the job of no value for its object, it constitutes a loss to the employer to the extent of the hours spent upon it, and the worker receives no premium. This remark does not apply to any completed machining operations prior to the one during which the fault declared itself. This is a perfectly fair arrangement, for the operation would cease at the discovery of the fault, so would never be completed.

When an employer is considering the advisability of introducing the premium system into his establishment, he would naturally formulate queries as to what it entailed in the way of administration, and what might be the best methods of procedure. The author would here venture a word of warning. Do not touch the premium system unless fully convinced as to its advisability and adaptability to the case, and then only with a firm determination to carry it right through.

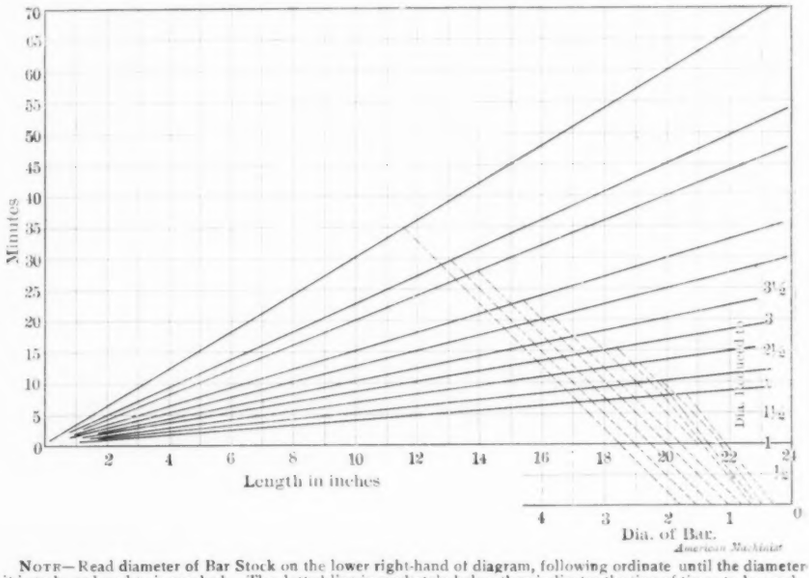
The initial work is both arduous and costly as compared with some other systems. It also takes time to get into working condition, and the work of organization must be thoroughly tackled. The whole work should be under the direction of a competent man, and there should be no attempt to half do it. To put the work of time-setting upon the frequently overburdened shoulders of foremen would be fatal to its success, as any hurried estimating of times is certain to cause dissatisfaction to either the worker or the employer. The fact that the times when set are to be standard, means that the machining operations must be carefully considered, and times assessed for every operation that constitutes the whole work upon the job.

Full records of the detailed time-setting should be preserved for reference, as should also the times required to do the work, as this becomes valuable information for future guidance. This, in an establishment of moderate dimensions, means an amount of work which will call for a staff of trained men constituting a time-setting and recording department.

The time-setting sheet used by the firm with which the author is connected, is shown in Tables 1 and 2, with illustrations of its use on two typical jobs. Examination of these will show that the work of time-setting is done in a methodical way, with due consideration of the feeds and speeds of the machine that are possible as applied to the particular job.

It is found by experience that by observing the time spent in various ways upon particular pieces of work, that of the total time required to do the work, a certain proportion is, of necessity, spent upon the work that may be broadly classed as handling, and that the remainder of the time is spent in actual cutting operations. The handling time would consist of preparing the machine, lifting in the work, setting tools and grinding same, gaging, etc., and that with different kinds of jobs, this handling time may be of different percentages of the total cutting times, varying between wide limits.

When such observations are made and recorded it very much simplifies the work of time-setting, for it then becomes merely necessary to work out the surfaces to be tooled, and the time required to machine them with given cuts, feeds, and speeds. Of the net tooling time so obtained, the handling percentage is taken and added thereto, producing a total which indicates the net time in which the job can be done. Upon this time, a further addition should be made in order to give the worker an opportunity of making a suitable premium. When considering this added time, in general, it is not advisable to cut things too fine. It rather pays to err on the side



NOTE—Read diameter of Bar Stock on the lower right-hand of diagram, following ordinate until the diameter it is to be reduced to is reached. The dotted line immediately below then indicates the line of times to be used.

FIG. 2. REDUCING BAR IN TURRET LATHE—PROVED UP TO 2½-INCH BAR ONLY.

of generosity than to be niggardly in this matter, as it is generally found that with finely cut time, the actual time spent upon the job by the worker is greater than if more liberal time is set. This no doubt is due to the moral effect produced. Thus the author would repeat, that considering all things, it pays to be somewhat liberal in time-setting, rather than the reverse.

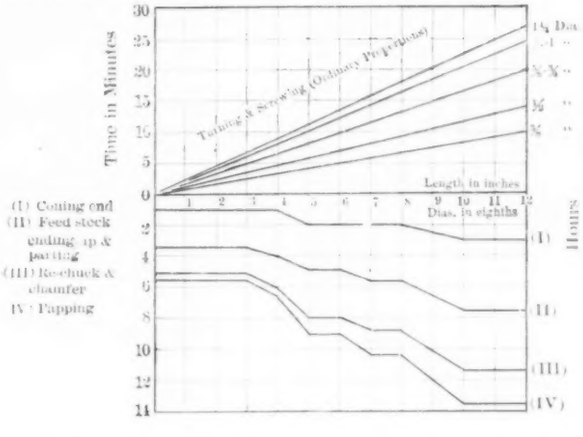


FIG. 3. TURNING BOLTS FROM HEXAGONAL BAR ON HERBERT OR J. & L. LATHE.

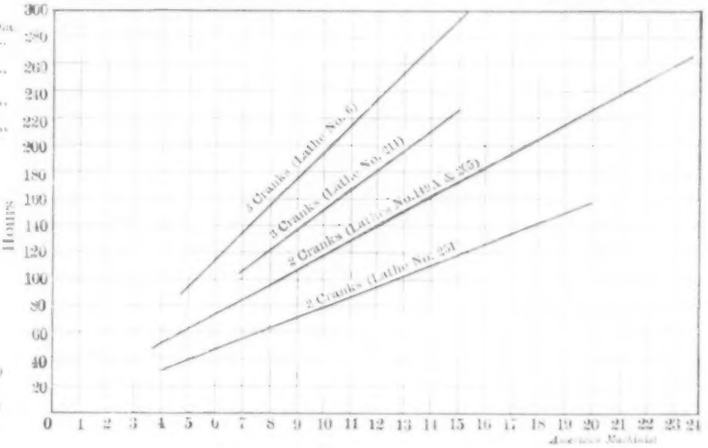


FIG. 4. TURNING CRANK SHAFTS.

As an aid to time-setting, the author would indicate a few ways of easing labor. As frequent reference has to be made to the feeds and speeds of machines, a carefully compiled series of tables should be prepared of every machine tool with its capacity, feeds and speeds, together with any remarks as to its tool equipment, faults, etc. See Table 3.

When a series of similar jobs of varying sizes have to be machined, it is convenient to take some proportionate dimension and plot along the abscissæ of a diagram and the allowed times as ordinates, producing a curve of times for a given machine, taking the extreme and several intermediate sizes. From such a diagram other times may be read as required.

PREMIUM TIME CARD

105, 106, and 107 Catalogue Number.
12 Engine Size.
Drawing No. *3621.*
Description of Work *Set of 3 Cylinders*
Operation *Planing.*
On Machine Number *147.*
Time allowed per piece *307 hours per set.*
Ditto for preparing Machine *included.*

Progress Ticket No.	Quantity	Per cent Premium	Time taken per piece	Progress Ticket No.	Quantity	Per cent Premium	Time taken per piece
9345	set	18.7	150¾				
13772	do.	32.7	127				
13151	do.	35.1	121				

American Machinist

FIG. 5. FILING CARD FOR TIMES AND RESULTS.

For instance, for plain turned jobs of varying lengths and diameters, a multiple of the diameters into lengths may be set off along the horizontal of a diagram, with allowed times as ordinates, as in Fig. 1. Such diagrams may be extended very considerably as in Figs. 2 and 3,* which the author has prepared for time-setting on turret lathes dealing with bar work, and in Fig. 4. It is possible with such diagrams, to allow for the various failings or facilities for production of the different machine tools available for the class of work, by adding other lines of proportionate values. This is clearly illustrated in Figs. 1 and 4.

Another little convenience is Barth's time-setting card. If this is modified to suit individual machines by adding an extra circle and pointer with lines indicating cone steps, it is possible to drop immediately upon the cone steps required to give the nearest cutting speed to that best suiting the job, together with the time required for machining.

No doubt members will readily think of other labor saving methods of simplifying the work of time-setting.

For filing the standard times and records, probably a suitable card system has advantages over books. Both the front and reverse of a card arranged by the author for this purpose are illustrated in Fig. 5. This card together with the others illustrated are used in the establishment where the author has introduced the premium system.

As the whole matter is based upon time, some suitable means of checking the starting and finishing times must be employed to ensure correct bookings. This may be done upon a job card or progress ticket such as is illustrated in Appendix D. This ticket is issued to the workers by a ticket clerk who fills in the necessary information respecting the job, together with the man's name, number, and the machine number, and he also punches the ticket in the square corresponding to the starting time, differently shaped punches indicating a. m. or p. m. At the completion of the job the ticket is again punched in the portion of the ticket on the reverse marked finishing time. This enables the time spent on the job to be calculated. In the event of a job being suspended from any cause, a note to that effect is made upon the ticket and the time of resumption is also stated.

* * * * * *

The author has found that reductions in time and cost have been more than expected, for it is by no means uncommon to find work costing as much as 30 per cent. less when worked by premium than it had hitherto cost by piece-work.

* * * * * *

As comparing the results of piece-work and the premium system as affecting costs,

FRONT:

Progress Ticket No. *12861*

Machine No. *203* Order No. *11067* Drawing No. *3549*
Day Man's No. *511* Name *G. Rosen* Rate of Wages
Night Man's No. Name Rate of Wages
Work *6 Connecting Rods.* Size *3*
Process *Slotting Complete.*
Date given out *28/3/03.*
Date Finished Day Wages
Hours Allowed *60* Night Wages
Hours Taken Total Wages Cost
Machine Cost
Total Cost
Marker Off Checker Passed by
Brown, Lindley & Co., 0/9/L.L. Starting Time. All Entries on this Card to be made in ordinary time.

12	1	2	3	4	5	6	7	8	9	10	11	12
6												

BACK:

Daily Time Spent on Job.
To be entered from ○ Time clock by a clerk.

Day Man						Night Man					
Date	No.	Hours	Date	No.	Hours	Date	No.	Hours	Date	No.	Hours

Finishing Time.

12	1	2	3	4	5	6	7	8	9	10	11
6											

Note. Starting and finishing times punched in the spaces provided to the nearest quarter of an hour the shape of Punch indicating a.m. or p.m.

American Machinist

FIG. 6. PROGRESS TICKET AS ISSUED TO A WORKMAN.

*Fig. 2 is not entirely clear to us. We judge that after tracing vertically to the reduced diameter, the dotted diagonal found at the intersection should be traced to its upper end, and the full diagonal there found be then followed to the vertical passing through the length of the piece, when, tracing to the left, will be found the time to be allowed for doing the work. The meaning of the word *papping*, on Fig. 3, is unknown to us.—Ed.

the author has prepared a sheet of results, showing at the same time the percentage premium paid to the worker. See Table 4. These jobs were done as nearly as could be ascertained on the same machine.

With a view to ascertaining whether the men are losers by the change, the author has summed the whole of the work done by premium at the works of the firm named, and finds that the average percentage of balance paid from the start is 20 per cent., while for seventeen consecutive weeks it has averaged 25.5 per cent.

The success of any scheme of remuneration or working depends largely upon those who administer it, and because it is successful in one place is no proof that it will be so at another. Even as in the case of piece-work, while it may produce satisfaction to both workers and employers at one place, it may, if not administered equitably and fairly, fail to come up to expectation at another. Honorable fulfillment of all agreements, especially regarding the standardized times, should be the keynote of its administration.

In conclusion, the author would respectfully submit to his fellow members for their consideration, the thought that one of the most important principles of management, is, to create unity of interests between those whose help is needed, even in the most menial capacity, and the employer; and, that this can best be done by instituting such a method of remuneration as is provided in the premium system.

Piece Work Price.	Premium Cost.	Premium Balance Paid, %	Piece Work Price.	Premium Cost.	Premium Balance Paid, %	Piece Work Price.	Premium Cost.	Premium Balance Paid, %
Each.	Each.		Each.	Each.		Each.	Each.	
s. d.	s. d.		s. d.	s. d.		s. d.	s. d.	
19 0	10 2	20.9	8 0	7 7	18.1	45 0	33 10	21.6
7 4	3 10	20.9	20 0	15 10	21.6	1 1	0 9½	28.1
8 6	4 9	29.0	2 11	1 9	18.8	0 10	0 8	39 0
1 2	0 6	27.2	25 0	17 3	17.9	0 2	0 1¼	
0 10	0 3½	23.1	25 0	18 0	16.5	0 3	0 1	
0 6	0 5		26 0	25 7	30.7	25 0	17 9	30.4
0 6	6 6		12 0	8 9	20.3	4 6	3 9	35.2
0 8	0 4½		16 0	13 8	22.8	25 0	17 0	33.0
0 8	0 6	20.0	11 6	10 7	23.1	1 1	0 8	30.1
32 0	13 7	18.0	12 0	8 9	19.0	25 0	16 8	25 6
24 0	16 4	14.0	13 0	10 9	25.8	1 4	1 0	20.4
25 0	16 9	14.0	4 10	2 9	20.8	0 5	0 4	26.0
13 0	7 7	28.3	4 0	3 11		0 8	0 6	
7 6	4 11	23.5	4 11	4 4	19 8	0 8	0 6¾	
4 9	3 6	23.0	5 0	3 3	25.0	26 0	16 6	31.1
32 0	16 0	9.7	7 8	5 6	23.2	0 10	0 7	31.5
1 6	1 2	43.7	1 5	1 0	16.1	0 4	0 3	31.5
1 5	0 11	26.4	3 0	1 3	28.5	14 0	6 10	26.0
1 3	1 1½	24.0	3 11	3 5	24.2	2 0	1 8	
25 0	16 2	29.3	4 0	3 0	6.8	5 6	3 0	34.0
2 0	0 9	13.4	4 0	3 7	12.4	2 4	1 6	33 2
1 8	1 0		7 8	5 3		26 0	22 9	25.0
3 0	1 3		0 8	0 6	14.2	3 0	0 9	30.1
15 9	13 1	23.8	6 4	3 10	19.1	4 3	3 7	20.0
			4 8	4 0				

TABLE 4—COMPARISON OF PIECE WORK AND PREMIUM COSTS.

The proposed new revised Constitution, By-Laws and Rules of the A. S. M. E. have been sent to the members for inspection and suggestions, previous to the Saratoga meeting.

An Expense That Was Not Saved.*

Recently I stood forty minutes to observe the movement of five cases of finished cloth from the packing room to the storehouse. In the operation six men and two horses were employed. Three men ended the cases upon a truck and wheeled them to the elevator, then a drop was made to the ground floor. The combined effort of five men was used in getting the cases from the elevator to the platform of a dray. A driver handled the ribbons while the load was moving the 600 feet to the storehouse, the five lumpers being part of the load, then, at the other end of the line the six men were required in the unloading of the dray and the conveying to another elevator, which in two loads took the material to the second story of the storehouse, where other men loaded it again and wheeled it to its resting place.

It was a rather singular anomaly that inside the buildings of the various departments of the plant, expensive machinery was being driven to its utmost capacity that the cost of production should be reduced, while here were at least 240 minutes of manual and animal labor expended in a simple problem of conveying. The cost for this operation, not including time of horse, interest on horse, wagon, harness, etc., was at least 60 cents.

I will tell you what that 240 minutes was worth to the agent of that mill, and to his stockholders, if an equally careful surveillance had been exercised in indoor and out of door economies.

Fifty cases of the same weight could have been transported between the same discharging and receiving points, the energy employed being a telpher outfit, a telpherman and a helper, and the entire cost, reckoning interest on plant, depreciation, power and wages, would be less than one dollar. I would like some mathematician to figure the loss in capital energy by reason of the cited carelessness on the transportation side of production.

* Clarence J. Messer before the New England Cotton Manufacturers' Association.

Rewarding Labor.

H. L. F. Orcutt, in a paper read before the Institution of Engineers and Shipbuilders of Scotland, discussed the subject of "Tools and Gages in the Modern Shop," and in the course of his remarks had the following to say about rewarding labor:

"This question is a large one; it is important, and rapidly coming to the front. It can be but barely touched on in passing, as it especially relates to tool and gage equipment. Generally speaking, it may be said that progress has been made industrially, but not economically. The increased use of labor-saving tools, the separation into departments, the specializing of operations, the increase in size of engineering undertakings have brought about changes, so that what is known as the 'factory system' displaces the old conditions (preferable in a social sense) under which master and man knew each other. Now, 'systems' must largely take the place of the individual responsibility upon which manufacturers formerly depended. This is particularly true as relating to the tool and gage outfit. Under the modern system it will be found necessary to devise methods of rewarding labor which will assist to create and satisfy a class of workmen, of which there is at present a comparatively small supply; I refer to 'toolmakers.' All is not done when engineers give more attention to training this class of men. They must pay them so that they can retain them and satisfy them. The prevailing standard of toolmakers' wages is not such as to attract great numbers of men of intelligence and superior training, which are called for in designing, making and keeping in repair a modern outfit of tools and gages. Yet without such men a modern shop cannot be maintained in an efficient condition.

"On the other hand, we find new conditions to deal with in the ordinary machine attendant. His demands must be so satisfied that he will be content day after day to do work which is little more than uninteresting routine, and still exert himself to turn out the highest product of which his tools and machines are capable. It seems to me that what is known as the premium system best meets the demands of the machine operator, and that high day wages are necessary for the 'toolmaker.'"

Engineering Reminiscences—XI.

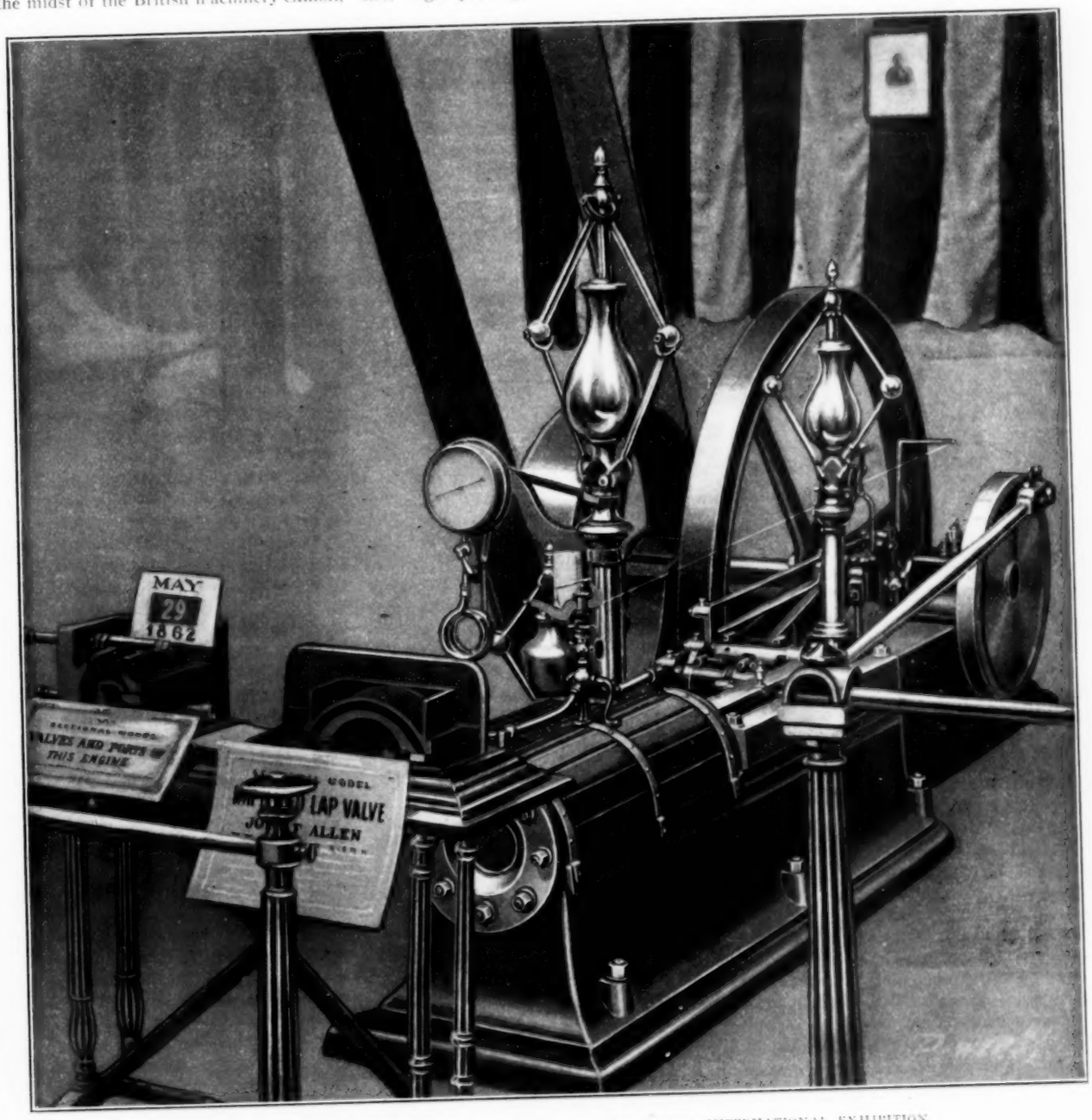
[Copyright 1902.]

BY CHARLES T. PORTER.

And so, as the result of a remarkable combination of circumstances, on which I look back with feelings more of awe than of wonder, the high-speed system made its appearance in the London International Exhibition of 1862, installed in the midst of the British machinery exhibit, from a photograph will, with the help of a little explanation, make this quite real.

The location was in a narrow space between a side aisle and wall of the temporary wooden structure, 300 feet wide by nearly 1,000 feet long, which formed the machinery hall. It was crowded closely by looms on both sides. Here were shown together the first high-speed engine, the first high-speed governor and the first also the largest and the smallest sizes of my stationary engine governors. These were belted from the shaft to revolve so as to stand always in positions coincident with those of the governor which regulated the engine.

On a table between the railing and the head of the engine I showed mahogany sectional models of the valves at one end of the cylinder in the engine exhibited,



THE ALLEN ENGINE EXHIBITED BY MR. PORTER AT THE LONDON INTERNATIONAL EXHIBITION.

under conditions more advantageous than any which I could have imagined. But the engine had a weak feature. It was wanting in an essential respect, of which I was, and remained to the end, quite unconscious, as will presently appear. Before entering on this subject, I will give the reader an idea of what the exhibit was like. The accompanying half-tone high-speed indicator. My marine governor could not be accommodated there, and had to be shown elsewhere. I was so much afraid of deflection or vibration of the shaft, that I shortened up the length between the bearings and placed the driving pulley on the overhanging end of the shaft, which for the light work to be done there answered sufficiently well. I showed and of the now well-known Allen slide valve, with double opening for admission made by a passage over the exhaust cup.

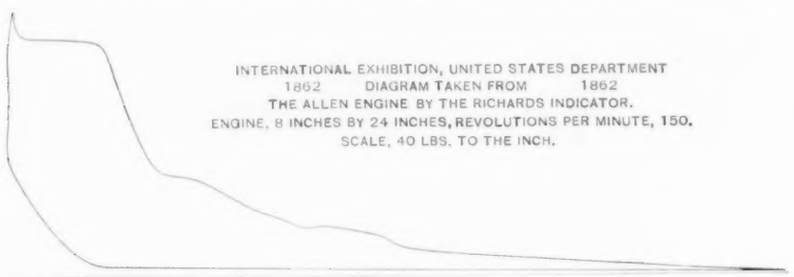
The Richards indicator is seen placed on the cylinder midway of its length, and connected by pipes with the ends over the clearances, so that in the now familiar manner by means of a three-way cock the opposite diagrams could be taken on the

same sheet. After a few days' use I mistrusted that the lead lines were not correctly drawn, and I took away these pipes, placing the indicator on the cylinder itself, at the opposite ends alternately. The diagrams then taken showed that the error from transmission through these pipes had been even greater than I had feared. I have of course employed the close connection ever since.

This identifies the time when the photograph was taken. It must have been within a few days after starting.

The center of the eccentric coinciding with the crank, as already stated, and the center line of the link being in the same horizontal plane with that of the engine, I was able to take the motion of the paper drum from the sustaining arms of the link, instead of from the crosshead. This was very convenient.

During the first two or three weeks the steam pressure was kept up to 75 pounds, as intended, and I was able to get diagrams cutting off quite early, which were then erroneously supposed to show superior economy. But when all the steam eaters had got in their work the pressure could not be maintained much above 40 pounds, and for that exhibition the day



INTERNATIONAL EXHIBITION, UNITED STATES DEPARTMENT
1862 DIAGRAM TAKEN FROM 1862
THE ALLEN ENGINE BY THE RICHARDS INDICATOR.
ENGINE, 8 INCHES BY 24 INCHES, REVOLUTIONS PER MINUTE, 150.
SCALE, 40 LBS. TO THE INCH.

of fancy diagrams was over. Gwynne & Co. showed a large centrifugal pump driven by a pair of engines which always brought the pressure down at the rate of a pound a minute. They were not allowed to run longer than fifteen minutes at a time, but it took a long time after they stopped before the pressure could be got up again even to 40 pounds. Whenever I took a diagram somebody was always standing ready to take it away, and so among my mementos I have been able to find none cutting off earlier than the one here represented. On the wall at the back I hung the largest United States flag I could find, with a portrait of President Lincoln. This seems all that needs to be said about the photograph and the diagram.

But what was the matter? I will clear the way to answering this question, by relating the following incident: Six months later, with a feeling of bitter disappointment, I contemplated my engine standing alone where the place had been thronged with surging life. All the other exhibits had been removed. This was left in stillness and desolation, and I was making up my mind to the necessity of shipping it home again, its exhibition to all appearance absolutely fruitless—a failure, which I was utterly at a loss to comprehend, when I had a call from Mr. James Easton, the same man who had first welcomed me in England. His firm had perhaps the largest exhibit in the Machinery Hall, and they had been frequent observers of the running of my engine, which was quite near them. Mr. Easton bluntly asked me if I thought my engine could be run 50 per cent. faster, or at 225 revolutions per minute, because they had concluded that it could be, and if I agreed with them they had a use for it themselves. Under the circumstances I did not hesitate long about agreeing with them in respect to both ability and price, and the sale was quickly concluded. I noted an entire absence of disposition to take an undue advantage. Mr. Easton then told me that they were troubled with lack of power every afternoon when the foundry blower was on, and had long wanted to drive this blower independently. It needed to make 2,025 revolutions per minute to give the blast they required, and they had planned to drive it by a frictional gearing, nine to one, if my engine could run at the necessary speed. So this most peculiar and exceptional opportunity for its application, absolutely the only chance for its sale that had appeared, and that at the very last moment, prevented my returning home in disappointment. It is hardly necessary to add that the engine proved completely successful. I shall refer to it again.

The point of the incident is this: It established the fact, the statement of which otherwise no one from the result would credit for an instant, that, from the afternoon when the black and averted looks of my loom exhibitors were changed to smiling congratulations down to the close of the exhibition, the engine never once had a warm bearing, or was interrupted for a single moment. It was visited by every engineer in England, and by a multitude of engine users, was admired by everyone, and won the entire confidence of all observers in its speed, its regulation and the perfection of its diagrams; and yet in all that six months not a builder ever said a word about building it, nor a user said a word about using it; and, as week after week and month after month passed without a sign, I became almost stupefied with astonishment and distress.

The explanation of this phenomenon was entirely simple, but I did not know it, and there was no one to even hint it to me. I was among a people whose fundamental ideas respecting steam engines were entirely different from those to which I had been accustomed, and I knew nothing about them, and so could not address myself to them. In the view of every Englishman a non-condensing engine was rubbish. Those which were made were small, cheap affairs, mostly for export. Neither a builder nor a user could regard a non-condensing engine with the slightest interest.

Now I do not think that in my limited sphere of observation at home I had ever seen a condensing stationary engine, except the engine which pumped out the dry-dock at the Brooklyn Navy Yard. In my mind condensing engines were associated with ships and steamboats. At this exhibition also there were shown only non-condensing engines. I did not think of the reason for this, that in this part of London, far away from the Thames, no water could be had for condensing purposes. I took it all as a matter of course, though I was astonished at the queer lot of engines in the company of which I found myself.

I was of course familiar with the development of the stationary engine in England, from the original type, in which the pressure of steam below that of the atmosphere, and sometimes the pressure of the atmosphere itself furnished the larger proportion of the power exerted; but after all I carried with me my American ideas, which were limited to non-condensing engines, and had no conception of the gulf that separated my thoughts from those of the men about me.

My visitors always wound up with the same question, "How do you drive your air pump?" And in my innocence I uniformly replied, "The engine is a non-condensing engine; it has no air pump": all unconscious that every time I said that I was consigning the engine to the rubbish heap. This reply was taken necessarily as a frank admission that the high-speed engine was not adapted for condensing. Of course then it had no interest for them. No doubt many wondered why I should have troubled myself to show it there at all. If I had thought more deeply I must have been struck by the unvarying form of this question, always assuming the air pump to be a part of the engine, but which of course could not be used there and only inquiring how I worked it; and also by the fact that after getting my answer the questioner soon departed, and I scarcely ever saw the same visitor again. But I did not think deeply. Perhaps the conditions of excitement were not favorable to reflection. All I thought was that this same everlasting question, which at home I would never have heard, was getting awfully monotonous. After a while this annoying question came to be asked less and less frequently, and also the engine attracted less

and less attention. The engine had failed in a vital respect, and I did not know it. That the fact of the engine being noncondensing should have been an objection to it never once entered my mind.

But I doubt if I could have bettered the matter, however alive to this difficulty I might have been. I showed all I had yet accomplished. In the minds of my visitors it no doubt appeared impossible to run an air pump successfully at such speed; the water and air would be churned into foam, and the valves would not close in time. This objection I was not prepared to meet, for I had not thought on the subject at all. Moreover, it could not have been met in any way except by a practical demonstration. For that demonstration I had yet to wait five years.

There were many things connected with this season which were well worth remembering. One of these was the visit of the jury. It was the only time I ever met Professor Rankine. There were two or three Frenchmen on the jury, and they engaged in an animated discussion of the question whether the steam could follow the piston at so great a speed. I well remember the sharp exclamation with which Professor Rankine put an end to this nonsense, when he had got tired of it. "There is no limit to the speed at which steam will follow a piston."

One day I had a call from Mr. John Penn, Mr. William Fairbairn and Mr. Robert Napier, who came together on a visit of ceremony, and presented me their cards. In return I presented to them the cards of the engine. But their visit, like most others, closed with the same inevitable question.

It was a delightful hour that Mr. Webb spent with me. He was then assistant engineer under Mr. Ramsbottom. He told me about the new form of traveling crane invented by Mr. Ramsbottom for the shops at Crewe, which was driven by a flying rope, a ¾-inch cotton cord, and also of other inventions of Mr. Ramsbottom—among these the automatic cylinder lubricator, in which the condensation of the steam was so rapid, from the locomotive rushing through the atmosphere, that only the water formed on the conical end of a bolt was permitted to drop into the oil, other condensation running into a circular trough and back through an external gooseneck pipe to the steam chest; and of their experiments to observe the rate of this condensation. For this purpose they used soda water bottles, which they found capable of resisting a pressure of 200 pounds on the square inch, and in which they could see the rapidity with which the condensed water displaced the oil, thus leading to the above device for limiting this action; also about the Ramsbottom piston rings, which came to be, and still are, so largely used. These consist, as is well known, of square wrought-iron rods, say ½ inch square, two for each piston, sprung into grooves. What is not so generally known is the way in which these rings were originated, which Mr. Webb then described to me. As sold, these are not circular rings, but when compressed in the cylinder they became truly circular and exerted the same pressure at every point. The original form was found for each size in this way: A circular iron table was prepared, provided with a large number of pulleys located radially and equidistant around its edge. A ring of the section of the proposed rings, turned to the size of the cylinder, and cut on one side, was laid on this table, and cords were attached to it at equal distances passing over these pulleys. Equal weights were hung on these cords, sufficient to expand this ring to the extent desired. The form of the expanded ring was then marked on the table, and to the lines thus obtained the rings were then rolled. He told me also of the trough and scoop invented by Mr. Ramsbottom, and now used the world over, for refilling locomotive tanks while running at full speed. Being a locomotive man, Mr. Webb did not ask about the way I drove my air pump.

Mr. Clark formed a scheme to indicate all the engines in the exhibition, twenty-four in number, all English except mine, so far as I remember, and employed my indicator for the purpose, the diagrams being taken by myself. Only two exhibitors declined to have their engines indicated. Indeed, as I afterwards learned, most of the engines were bought for use there, as exhibitors would not exhibit noncondensing engines.

One of those who refused permission were Gwynne & Co., the principal a nephew of my centrifugal-force friend of earlier days. They employed Mr. Zerah Colburn, then editor of *The Engineer*, to investigate their pair of engines and find out why they used so much steam. He borrowed my indicator to make a private test. Of course I never saw the diagrams, but Mr. Colburn informed me that by making some changes he had reduced the back pressure to 7 pounds above the atmosphere, which he claimed to be as good as could be expected. No material improvement in the engines was to be observed, however.

Some of the diagrams taken on these tests exhibited almost incredible faults. The only really good ones were from a pair of engines made by Easton, Amos & Sons, also to drive a large centrifugal pump, built for drainage purposes in Demarara. These showed the steam cut off sharply at one-third of the stroke by separately driven valves on the back of the main slides. A mortifying feature of this work for myself was that on testing the indicator Mr. Clark found that the area of the piston, which was represented to be one-quarter of a square inch, was really considerably less than this, showing lamentable inaccuracy on the part of the makers, as well as my own neglect to discover it. This rendered the instrument valueless for measuring power, but it showed the character of the diagrams all right.

Piecework and Premium.

Chiefly that our American readers may understand the great amount of attention which the premium plan is receiving in Great Britain, we reproduce an editorial which appears under the above heading in the *Engineer* for April 17. Abstracts from one of the papers referred to in the first sentence are given in another column, as they explain interesting particulars of English methods of recording and determining the time limits. We have already given our opinion of Mr. Rowan's modification in replying to Mr. Booth at page 556. We have also at various times given our understanding of the reasons which give a much greater prominence to the rate fixing department in England than here. Following is *The Engineer's* article:

"If any excuse were necessary for turning again to a subject which has occupied a good deal of space in these columns, it is to be found in the fact that two important papers on that subject—the premium system—have been recently discussed, and that, in spite of all that has been said and written, there is still haziness in some quarters as to what the premium system is in the first place, and what it claims to do in the second. Of the first, we have nothing to say. If there are employers who do not know what the premium system is by now, it is entirely their own fault—there is no lack of material wherewith they may inform themselves. Of the second, however, a word or two is necessary. Both at the London meeting and at the Manchester meeting there was an attempt to detract—we do not express it too strongly—from the system itself, and to give the credit for the improvements which have resulted from its use to better organization. The advocates of the systems have never denied that this is to a great extent the case; in face, they have absolutely claimed as one of the advantages of this method of payment that it necessitates active and intelligent management, and gives the best results when it is coupled with exact systems of estimating and keeping costs. Mr. Rowan, and other users, indeed, have gone so far as to regard these things as essential to its satisfactory working. It is conceivable that if similar organization existed where piecework was in force, equally good results might ensue; but—and we can carry our argument to no firmer foundation—experience has shown, in too many cases to admit of their being regarded as exceptional, that the premium system, whether on account of the organization which accompanies it or on account of the system of payment apart altogether from secondary features, or on account of both together, has advantages over any other method of remunerating workmen that has been yet devised. And if that is true of the system

as a whole, it is doubly true of the Rowan plan, because not only does that system hold out a higher inducement to the workman for the first few hours saved, but it so tails off the gain in the latter hours that a very high rate per hour, the bugbear of piecework, is unattainable. It would only weary our readers to traverse again arguments with which they are already well acquainted, but we should like them to notice in passing that the staunchest defender of piecework at the Manchester meeting, Mr. Naysmith, made a very strong case when he opposed the limitation of the amount which a man might be permitted to earn per hour. It is the impossibility of preventing the introduction of such restrictions that is the weak point of piecework, and the strongest point of the Rowan premium system is that there is no temptation to adopt such disastrous methods. Is it necessary to say that, once such a restriction is imposed, the whole object of the system is defeated? The inducement to effort is removed, and instead of an automatic control which allows of very wide extension, we have an artificial limit fixed arbitrarily by the employer, which may be either too high or too low, and is rarely likely, as experience has shown, to be just correct.

"On this question the experience of all employers who have used the premium system would convince Mr. Naysmith that there is not that facility about fixing a standard time which he had in mind when he contended that if the time were properly fixed piecework and premium were on the same plane. It is one of the best features of the Rowan system that great accuracy in time fixing is not a necessity, and it is one of the stiffest feathers in the premium cap that it has falsified the best predictions as to the time that should be taken to do a job.

"Both Mr. Rowan and Mr. Ashford have insisted, we think unnecessarily, on the necessity of careful preparation for the introduction of the premium system, and on the need of what appears to be a very formidable amount of clerical work. Our own view is, and it is based on facts to which an important addition has been made only within a few days, that if Mr. Rowan's own system is employed, the premium plan may be started from day work with very little preparation, and with so little clerical work that an outlay of 10s. to 15s. a week may be expected to cover it. We are glad to have the support of such men as Dr. Barr and Mr. Massey in this contention, but it is when we turn to actual facts, and are able to see works of fair size starting in quite a small way and gradually developing the system, that we feel safest in advocating its adoption without hurry and with a full determination to carry it through, but also without waiting to accumulate tables of facts and figures, in the collecting of which there may be such weariness and expense that before an employer is ready to start he is tired of the whole thing; so much energy has been used up in the run that there is none left for the jump."

Numbering and Filing Drawings.

BY BELL CRANK.

S. A. Worcester describes, at page 557, a system of keeping drawings, which I cannot let pass without comment.

Everyone who has used a system of keeping and indexing drawings until very familiar with it, comes to think it the best system, and this accounts for the variety of "best systems" which have been offered to your readers.

Where there is much variety in the kind of machinery made, any plan of classifying the drawings of each kind of machine and trying to keep them together will ultimately prove to be inadequate and unsatisfactory. There is nothing to be saved by it, except at first, while there are only a few drawings of a class; but as soon as a considerable number of drawings are reached, the result becomes a loss instead of a saving. When so classified and stored, if anyone wants one of the drawings, instead of consulting a suitable index to locate it, he will almost invariably go and hunt over all the drawings in the lot until he finds it. In fact, this method of classifying and finding drawings is the oldest method known, and has been abandoned in most modern first-class drafting rooms.

An adequate system must be one which will provide for indefinite increase of any class, without waste of space and without any possible confusion of records. This can never be done if we must guess at the space or the number of drawings for any class, because there is sure to come a time when the amount allowed is insufficient for some classes, and then the plan must be compromised in some way which destroys its consistency and ultimate value.

A drawing size symbol is a great convenience—almost a necessity—in properly storing and indexing drawings, and I have never yet met with a real practical objection to it. A different letter for each size of drawings, with the consecutive number, is suitable, and there is no difficulty in selecting letters for this purpose so different, both in sound and appearance, that there would be no mistaking any one for another. If each drawing is plainly marked with size symbol and all drawers of that size also marked, then it is a valuable help to finding at once the group of drawers to which it belongs, and it saves time both in finding and in putting away drawings.

The method of consecutive numbering drawings is very important, and, if desired, all drawings, regardless of size, may be so numbered from the first, but a little reflection shows that these numbers would be of no value in indexing, because the successive numbers, referring possibly to several different sizes, cannot all be stored properly in one size drawer, and hence the number furnishes no indication where a drawing belongs. For this reason alone, if for no other, it is necessary to give each size of drawing a consecutive number, commencing with unity for each size. The drawers should be made so each may hold not to exceed 100 tracings, as more than that are inconvenient to handle, and fifty is better, except that it takes more drawers and more space to store the same number. The drawings may all be numbered consecutively in addition to the size and index number, regardless of size, if desired; but I doubt if it is worth the trouble, for where I have seen this done I never knew the second set of numbers to be used for reference. It might be of some use as a precaution and check against errors, like double-entry bookkeeping, but if so used, it would involve extra clerical work in all orders and records where drawings were referred to. It seems to me it would be much like having two different numbers for the same locomotive.

The drawings should be arranged in the drawers with the lowest number at the bottom, and each drawing should have its size symbol and number stenciled or printed on the lower right-hand corner. When drawings are returned to the drawer they must always be put in their place, so that the numbers come consecutively, like the page numbers in a book. The drawers, of course, should be marked outside to show what numbers belong in each drawer. With this system drawings can be put away without the use of an index, and they can be found in the quickest possible time. It is very inconvenient to use drawers with partitions in them, as it makes a cumbersome drawer to handle to get at the small drawings, and very little space is saved by it anyway. There are very few shops in which it is practical to have 90 per cent. of the drawings made of one size only, and it will pay to have a separate section of drawers for each size of drawing. When drawings are numbered and stored as shown by Mr. Worcester, putting small drawings in large drawers, when the first half or quarter size is made there must then be allotted 50 or 100 numbers to drawings not yet made, and possibly all these numbers may not be required for drawings of that size, and it thus leaves an unoccupied gap in the consecutive number system. Also further provision cannot be made for the smaller size drawings until the reserved drawer is filled, when the next vacant drawer ahead of the consecutive number must be specially partitioned for another lot of small sizes.

When each size of drawing has its own consecutive number system together with a size symbol, there is never any gap of vacant space or unused numbers, but each consecutive drawer is filled and each number is used on a drawing before any of the following drawers or numbers are

used. This uses all the space in the most economical manner possible, and the only empty drawers are those ahead of the last used number, just where they are wanted, and the only place they should be.

In arranging sections of drawers, the smallest may conveniently be placed above the larger sizes, and if necessary to place them so high as to be out of reach from the floor, a sort of staff may be made to reach up to the drawer, catching into the pull handle, so it may be pulled out and let down without the use of a step-ladder or something of the kind.

The record of consecutive numbers used for each size drawing need not present any difficulty, as in my experience it is never used for anything except to indicate the number to be used on each successive drawing and to prevent the same number being used on more than one. These records should be on a card index, to permit indefinite extension.

As to the possibility of mistakes due to the same number being used with different size symbols on drawings, I know where these numbers have been used for years to make lists of drawings to go in the shop to build machines by, and during a number of years while I was employed there, the only mistakes which occurred were such as could be entirely avoided by using size letters which were not similar in appearance or sound. This firm for a long time also numbered all the drawings consecutively, regardless of size, but finally abandoned that as being useless, as the number and size letter combined served every desired purpose. For a complete index to drawing titles or to parts shown on the drawings of course the card-index system is far better than any other system yet devised.

I do not claim that what I have described is the best system in use or that can be devised, but it is certain that it is entirely adequate to care for as great a variety of sizes as there will be any practical use for, and it is capable of the greatest required expansion without waste of space or confusion in the system.

I do not doubt that the system advocated by Mr. Worcester would be practically satisfactory where nearly all the drawings were of one size, that being the largest and the others half or quarter size; but as we never can know what the future demands may be, I think that the system adopted ought to be fully capable of meeting any possible future needs, when that can be done without having any seriously objectionable features.

The steam turbine has lately been used in the reversed direction for compressing air, an ordinary steam turbine being coupled direct to the air turbine. This air turbine is very similar to the steam turbine, and consists, as usual, of alternate rows of moving blades and guide blades, and is driven at a high speed, each row of blades increasing the pressure.

Echoes From the Oil Country.

"IMPROVED" PULLEY FACES AND LEATHER BELTS.

About as common a word as can be found in advertisements is "Improved." As I have had to do with these things I have found that it generally means "Changed." If all changes were improvements there would not be any hesitancy when a thing is heralded as "the latest 'improved.'"

Sometimes I have thought, and have said, that a thing was a good thing just because my experience had not been in the direction that revealed its weak points, and I had seen it from only one position. Often I did not know that there was any other position to see it from. Perhaps if we all waited until we knew all that there was to know on a subject before saying anything, the silence would be oppressive. If only I can, once in a while, stir up the man that does know, I feel that my effort has done some good. I seem to have run into one of these "improvements" lately, which, while it has been with me for quite a long time, has never had the combination to bring out all its possibilities.

I recall that I once read an article telling of how much better it was to turn the face of a pulley to a beautiful curve instead of just two chunks of cones set together. I am not sure that it wasn't some one with an "improved" pulley lathe that advanced the idea. At any rate, I remember that I rather felt sorry that I had to turn pulleys by setting over the tailstock, or, if they were small, by using the taper attachment.

I was relieved to find, on examining some new machinery that we had acquired and which was said to be the very best and latest design, that the faces of the pulleys were beautiful curves instead of being the old and "out of date" truncated cones that I had been familiar with; and which were accused of setting up such injurious strains in the belts. On trial it was seen that the belts ran very nicely, and there was good proof of the "improvement."

Unfortunately for my peace of mind, and the reputation, with me at least, of that style of crowning a pulley, there came a time when the belt men seemed to get so busy that they had to make up the whole hide into "high grade" belt, and I had some of the running of it to do. This grade of belt wants to treat the entire pulley alike and will run first on one side of the center line and then on the other, and for fear that it hasn't been entirely fair it will run up on the flange a bit; then, of course, the side of the cone has to receive the same attention. After a bit it seems to feel that the pulley should be introduced to the other side of it and it will flop over; then, feeling that it may have been too forward in its actions, it will flop back again. It will sometimes vary its performances by trying to go up and form the acquaintance of the next step of the cone without waiting for the ceremony of an introduction through the good offices of the lathe hand, and is then likely to find that such an active life is not suited to its constitution and break in two. When stretched out on the floor it will be seen to have assumed the form of a crescent, ogee, snake, or some other beautiful curved object. I never saw one that would make a complete circle when lying flat, but by cutting some of them to pieces and matching the curves to the best advantage a very respectable showing could be made in that direction.

Finding that belts from the same roll did not behave the same on all the machines, it was soon seen that the machines that had the round crown on the pulleys gave the most trouble, and it did not take very long to change some of the most troublesome ones to the old fashioned double conical crown, and in every case the change was a benefit. I do not think that any amount of benefit that could possibly come from the round crown would make up for its lack of hold on the belt. Since having my attention called to the matter in this disagreeable way I have changed the style of crowning on several machines, and, other things being equal, I will certainly give preference to the straight crowning in the future.

There is another thing that I do not like, but which is often found with the round crown, and that is the under cut of the flange. I would much rather have the room that it takes up than have it.

Of course if all the belts had been as good as they were supposed to have been I would as likely as not have gone on supposing that the style of the crowning was an improvement; but after going over the matter I cannot see anything in it to recommend it to anyone, unless it is much cheaper to make. In that case it might have some merit in the eyes of the maker. There is one very serious fault that is very common with the round crown, and that is that the highest part is not in the center of the face, but is just as apt to be closer to a flange as to be farther from it, and where it is not where it should be it is not nearly as easily detected as would be the case with the other style of crown.

If any practical man has ever found any difference in the life of the belt that he could trace to the strains caused by the differences in the shapes of the crowns I have not had the pleasure of meeting him, while I have met many that have had trouble with the "improved" shape.

The machine men may think that all I need to do to be rid of all trouble is to get first-class belt. I will let them into a secret. When times are good and everyone has all the business he can attend to, and sometimes a little more, leather "cut in a strip right off from the back-bone" will take on new and very surprising qualities, so surprising in fact as to induce hunting for something to take its place, and bring out the virtues of the cotton belt for the machine shop.

I am not a belt expert, so that I must confess that my knowledge of the quality of the belts rests on the statement of the salesman, the brand on the belt, and the statement of the maker to whom one of these strangely acting pieces was sent back. The maker assured me that the stock and cut were of the very best that the market afforded, and that he could not give any reason for the action of the belt.

The salesman, who evidently was keeping up with the times, said that it was due to the use of the high speed steels. Had it not been for an experience with one lathe his reason might have been viewed with more favor. On this lathe the cone belt had given out several times and the man running it had been given enough good new belt to put it into shape again, but the calls for new belt came oftener than was relished by the manager and a sharp eye was kept on the lathe. In a short time the belt was twisting over and running very crooked. The man was blamed for not taking proper care of the belt. In making explanation he called attention to one piece in the belt. This piece he said had been in for two years that he was sure of, and he did not know how much longer. This was interesting enough to cause the piece to be carefully cleaned and the brand showed that it was an old piece not now in the market. It was straight and in good shape. Three other brands of high grade belt had been used on the lathe, but as they had been subjected to the evil influences of prosperity they did not stand the work.

Perhaps some may think that it might have been the fairy tales of a purchasing agent that worked the spell, but this was not the case, as I had the personal assurance of the salesman that the belt (in the case that gave the most trouble) was their best grade, and guaranteed as good as any in the market; the price paid was full price, and when is added to this the testimony of the maker after he has had opportunity to see the belt, that the salesman was right in his claims, I don't think we can lay it to the purchasing agent, unless it be on general principles to make up for some of his sins that he is not caught at.

The correspondent who said that "strange things happen in the oil country" wasn't far from right. Perhaps that is the reason that belting behaves in such a way with me.

My experience with "light double" has not been very gratifying. Talking with belt men they all admit that there is much more likelihood of a poor piece of leather going into a double belt than into a single; they also confidentially inform me (and don't give the secret away) that most of the other makers of belts put stock and cuts into their double that they would not put into the same grade of single belting. Perhaps if the machine tool man will double the width of the pulleys on his next "improved" machines we will in time forget our troubles in these matters, or the individual motor on the machine may make the belt "out of date."

W. Osborne.

Proposed Standard Temperature for Standardizing Gages.

The French Society for the Encouragement of National Industry, whose labors in the interest of mechanical standardization are indefatigable, is now at work tentatively to the recommendation of a standard temperature of 15 degrees Cent. (59 degrees Fahr.) at which gages, etc., are to be measured. A meeting of the society last November approved a report of M. E. Sauvage, in the name of the Committee of Mechanical Arts, setting forth the arguments for the proposed adoption. From the January number of the *Bulletin* of the society we translate as follows:

"Gages, or calipers, representing the dimensions that one wishes to give to parts of machines, are to-day in common use in good mechanical construction. These measuring instruments are often executed with great precision, and in comparing them with the standards preserved for the verification of the gages in actual use, it is not rare to find in practice an approximation much closer than a hundredth of a millimeter, sometimes even to be reckoned in microns.*

"More and more it is required that mechanical pieces shall be interchangeable, even if they are made at different times and in different shops. More and more are being created types of pieces, as types of threads, of which the dimensions should be universally observed.

"In these conditions it is clearly advantageous to have the gages employed by different manufacturers as nearly identical as possible, whatever be the time or place of their construction. But an indispensable and very simple condition of this uniformity is that the temperature corresponding to a certain dimension for the gage be determined. If not so, the expansion of the metal may cause errors. With a coefficient of expansion of 0.000013, possessed by certain steels, two gages which represent a length of 50 mm., the one at 0 degree Cent., the other at 15 degrees, will in reality differ by about 0.001 mm., while a discrepancy of one micron is distinctly appreciable; for instance, when one compares mutually the play of two gages nominally alike, each formed of a ring adjusted on a plug.

This simple and important consideration is generally left vague. Consulting the catalogs of gage makers, one finds hardly an indication relative to temperature. When it comes to measuring instruments that truly may be called scientific, and notably the standards of the meter, this doubt does not exist; the standard must be at a temperature of 0 degree in order to have really the length of a meter or whatever it nominally may be. But as for industrial standards, it is generally unknown to what temperature they ought to be brought in order to have the dimensions they are supposed to represent. For purposes of comparison with original standards, it would be convenient to adopt for gages the temperature of 0 degree; but this comparison is made very rarely and by specialists, while for industrial gage making, a temperature of 15 degrees, differing little from that which generally rules in shops, is preferable.

"It is, moreover, of interest to use the gages at the temperature at which they give exact measurements. This would be no object if the pieces to be measured had the same coefficient of expansion as the gage; but in general this is not so; even steels do not expand alike, and it is often necessary to measure other metals than steel. From this point of view a temperature of 15 degrees* is much more convenient than 0 degree.

"If 15 degrees be adopted it is apparent that tool manufacturers must by special operations—which need very rarely be repeated—compare the standards which represent a meter or fraction thereof when they are at 0 degree with others which, in order to represent the same absolute measures, should be at 15 degrees. This comparison renders necessary a knowledge of the coefficient of expansion of the metal employed. But once in possession of standards which in order to agree with their nominal length must be at 15 degrees, there will be no need of further comparisons to consider the effects of expansion, provided the temperature is at 15 degrees.

"The Society for Encouragement is well in a position definitely to settle this important point, so as to prevent regrettable future differences. But the proposition in order to have a sufficient weight ought to be preceded by an inquiry among those principally interested. Although this is important, the question is simple and should easily be solved.

"The proposition of the Society might be thus formulated: 'It is indispensable to fix in a uniform manner the temperature at which gages, calipers and apparatus of precise measurement employed in industry ought to be placed in order to give as exactly as possible the dimensions that they indicate.'

"This proposition, with explanatory note, may be the subject of a circular sent to the manufacturers of measuring tools, to the principal mechanical constructors and to the technical societies. Abroad they may be addressed principally to the technical societies. Responses may be asked by June 1. These answers may be compared and discussed and form the basis of a definite proposition of the Society.

"This extreme minuteness of precision

*One micron = one-millionth of a meter = 1-25,400th part of an inch.

*Commandant Hartmann who has written on the standardization of industrial measures recommends 15°.

may seem excessive and of little use to those who by the nature of their work require only rather coarse gages, but it is proper to remark that the standards of measurement ought always to be established with the utmost possible precision, and in every case with a precision notably superior to that required for the object they determine. The precision obtained in practice in a great number of manufactures is, moreover, ever increasing."

Letters From Practical Men.

Molding a Special Branch Pipe.

Editor American Machinist:

I show here in detail the method adopted in molding a special 7-inch socket branch pipe, as shown in Fig. 1.

Two complete socket patterns made in halves in the usual manner were used. One of these served, in halves, for both ends of the straight portion of the pipe and the other for the branch. The former was connected, as shown in Fig. 2, with piece *A*, its width corresponding with the outside diameter of the pipe. This was next bedded in the foundry floor and rammed to the joint at the floor level.

The framing *B* was next fixed in position, the internal width of this framing being equal to the outside diameter of the pipe; the cross piece *D* was let into the bottom half of the socket pattern to half its thickness and fastened with screws in position; this was next rammed up to the joint and leveled with strickle 5, Fig. 3.

The other half of the branch socket was now placed in position, and strickle 3, Fig. 3, was used, the sand formed with this strickle being well rammed, so as to retain its shape during the process of ramming the cope.

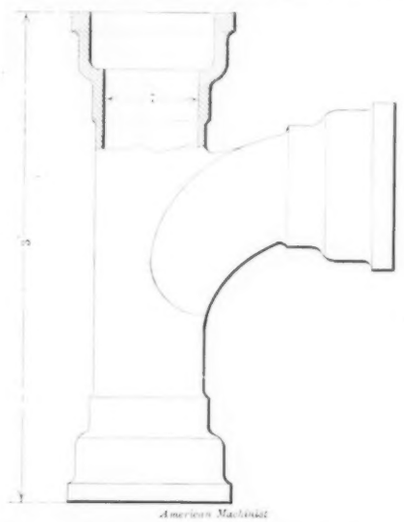


FIG. 1. SPECIAL BRANCH PIPE TO BE CAST.

Board *C*, corresponding with that of board *A*, was next placed in position, this being doweled to board *A*, as shown. The joint was now covered with parting sand and the cope was placed in position, staked and rammed in the usual manner.

After this operation was completed the cope was taken off and the two half-socket patterns withdrawn and placed in the cope and located by the impression already formed by board *C*. After this operaton was finished and the socket patterns were withdrawn, pieces 1, Fig. 3, were placed in both ends of the socket prints; these served as guides for strickle 4, Fig. 3, by which the body of the straight portion of the pipe was formed. Strickle 2, Fig. 3, was used to form the body of the bottom half of the branch. Joint boards 6 and 7 were used to fill in the impression made by the framing.

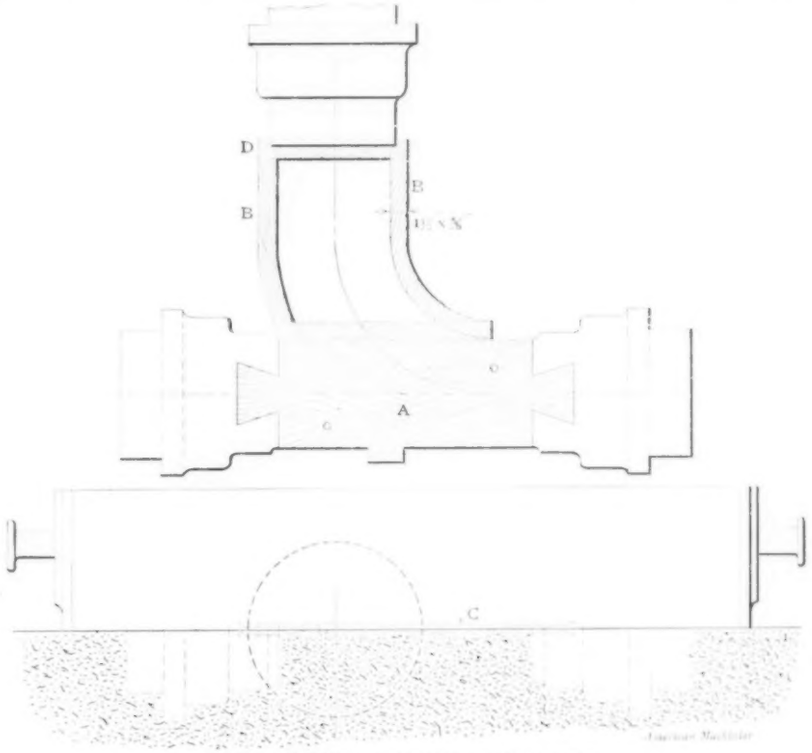


FIG. 2. MOLDING A SPECIAL BRANCH PIPE.

The demand for this pipe was one of those cases very familiar in the foundry department: "Get this cast as soon as possible," the method adopted and the casting produced giving entire satisfaction.

R. JONES.

Brymbo, N. Wales.

Responsibilities of Engineers' Licenses.

Editor American Machinist:

Being a licensed operating engineer, by reason of the Engineers' License Law, as applied to Greater New York, I am interested in any discussion or comment that may appear in your journal for or against the necessity for such laws, and should the views you express at page 628, current volume, be held by the courts to be sound law, it would smash the Engineers' License Act into "smithereens." The Engineers' License Law, though it often fails in its purpose through maladministration,* which will be referred to later on, was originally enacted to cover such cases as the man who thinks he is under no "obligation to decline responsibility" "on account of his own consciousness of unfitness for it," and to hold him "legally responsible for lack of personal efficiency." "The woods," as well as the cities, are full of men (and as we read now and then of "lady engineers" we may include women, too) who are ever ready to risk their own lives in occupations they are unqualified for. But really are passengers on a railroad train supposed to take the same risk as a reckless, ignorant engineer (?) who places himself at the head of the train under conditions, where, if an accident (?) occurs, his own life is likely to be forfeited?

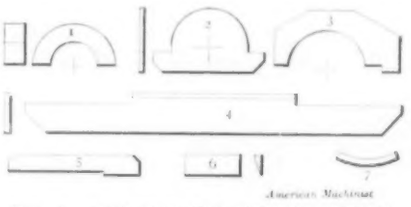


FIG. 3. STRICKLES FOR MOLDING SPECIAL BRANCH PIPE.

Again, the people of the State of New York, in their wisdom (?), "represented in Senate and Assembly," have enacted a law making it a misdemeanor to attempt suicide; so that, from my point of view, it does *not* "seem that such an assumption of risk is all society ought to require of a locomotive engineer," any more than this assumption of risk should be held a qualification for granting an applicant an engineer's license.

The failure of *all* present license laws

* Referred to page 629, AMERICAN MACHINIST.

to fulfill their ostensible purpose is, in my opinion (and this opinion is shared by many other engineers holding first-class certificates), due more to the first-class, second-class, third-class, special-class, etc., etc., clause than to any other cause. I am opposed to laws as un-American that place it within the power of an unscrupulous official to stigmatize, at his own sweet, or rather bitter, will, a man as first, second or third class, thereby placing the official stamp of inferiority on the brow of a worthy citizen, and compel him to advertise the fact by exposing "his certificate of character" to the public gaze where he is employed.

Physicians and others who are required to show their fitness to practice their chosen vocation, where the public safety is involved, are all, so far as their legal diplomas imply, on a par with one another. If there are any first, second or third class physicians they are so only by common consent, because of their success with their employers, and not through the official seal.

Another source of annoyance and injustice to the citizen is that he cannot get a license unless he is first employed, and his license permits him, if he gets one, to operate the plant specified therein only.

Again, who ever heard of the health officer dictating to a man whether he shall employ a first, second or other class physician? But the official engineer has been for years bold enough to dictate to the owner of a steam plant what grade engineer he shall employ, and if the owner is penurious the dictator will (for a consideration) permit him to employ a man with an inferior grade certificate, or he will grant the required grade (also for a consideration) to a man who "is under *no* obligation to decline responsibilities on account of his own consciousness of unfitness for them"; hence it is by the dishonesty of both the employer and employed the official becomes corrupt.

I shall not attempt to suggest a remedy for the evil in engineers' license laws enacted up to date, but it does not seem such a difficult problem but what a satisfactory solution could be obtained.

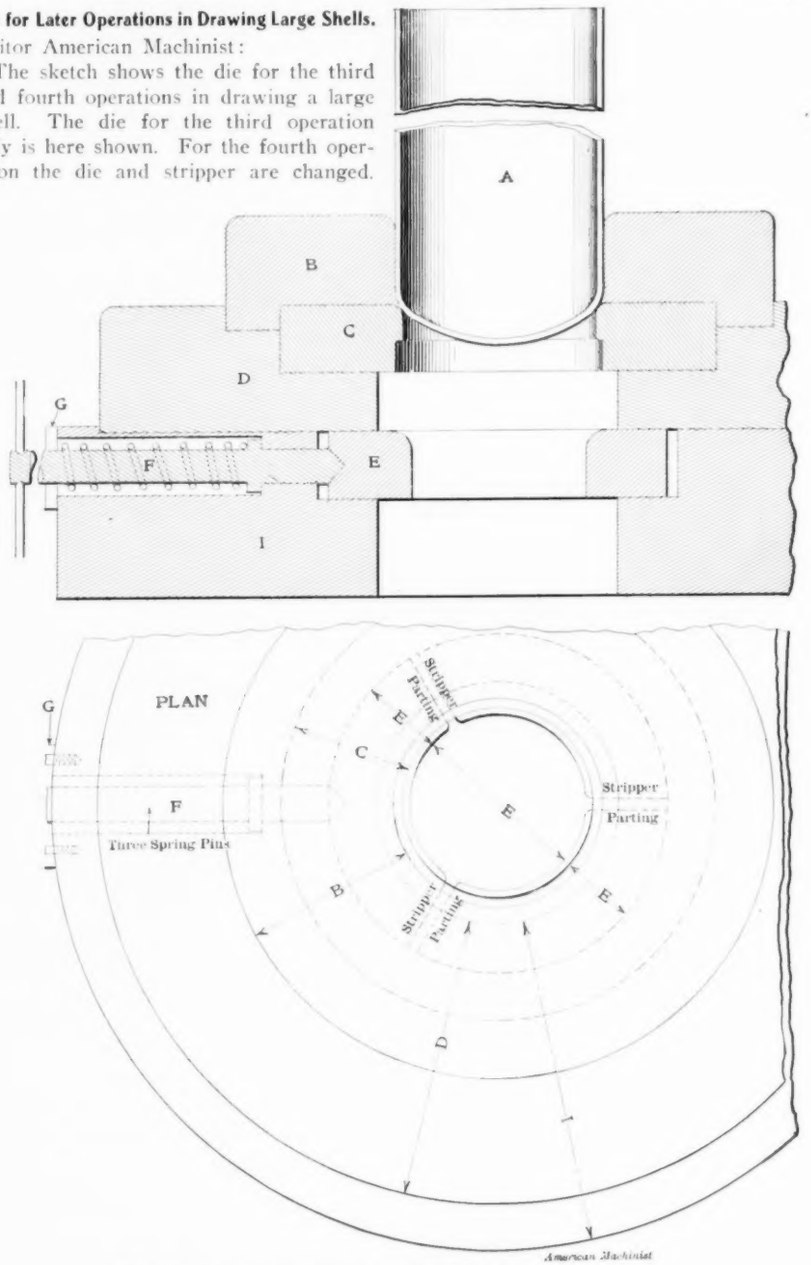
R. A. NIVEN.

[No license is required in the case of locomotive engineers. There are those who think there is as good reason for licensing them as for licensing marine or stationary engineers, but the fact remains that at present they are not licensed, and probably if a law were introduced proposing to license them, the railroad companies would oppose and defeat it. Large employers do not approve such laws, because they hamper them in time of labor troubles. This was clearly shown during the anthracite miners' strike, when it was claimed that the license law for miners prevented the operators from employing men freely. Our only contention is that a man in Engineer Wisker's place, who has served as fireman and is tendered a position as engineer, would be a fool to refuse it because he himself might have doubts as to his fitness for the place. Men are taking places every day with doubts on that point, and no one can certainly say in advance whether a man will or will not succeed in a given position. The only thing for an individual to do is to accept such responsibilities as others, knowing the facts, are willing to trust him with, and then succeed if possible.—Ed.]

Die for Later Operations in Drawing Large Shells.

Editor American Machinist:

The sketch shows the die for the third and fourth operations in drawing a large shell. The die for the third operation only is here shown. For the fourth operation the die and stripper are changed.



DIE FOR LATER OPERATIONS IN DRAWING LARGE SHELLS.

All the parts here shown are round, so that dies, gages and strippers for other articles may be fitted to them.

A is the shell after the second operation in position for the third draw. *B* is a cast iron or steel gage or guide. I have used cast iron, which answered its purpose very well and is easy to make. *C* is a steel die; the upper or entering corner is rounded, and after hardening is polished as smooth as possible. Too much care cannot be given to the finish of the parts coming in contact with the shell in drawing, as any roughness will show in the finished tube. The die is recessed, as shown, to do away with friction as much as possible. *D* is a cast iron holder in which die *C* and gage *B* are fitted. This is let into bolster *I* about ⅛ inch. *E* is the stripper, the upper corner rounded and the lower corner square. It is made of tool steel and tempered as hard as possible. The hole is bored the same size as that in the die. The piece is then cut into three equal parts. Care must be taken not to cut away any more than will allow the parts to close just enough to do the stripping, or, in other words, to

close around the punch after the shell passes through.

On the down stroke of the punch the stripper is forced open, allowing the shell to pass through, after which the stripper is closed against the punch by springs acting against pins *F*; the stripper is in position to strip on the return stroke of the punch.

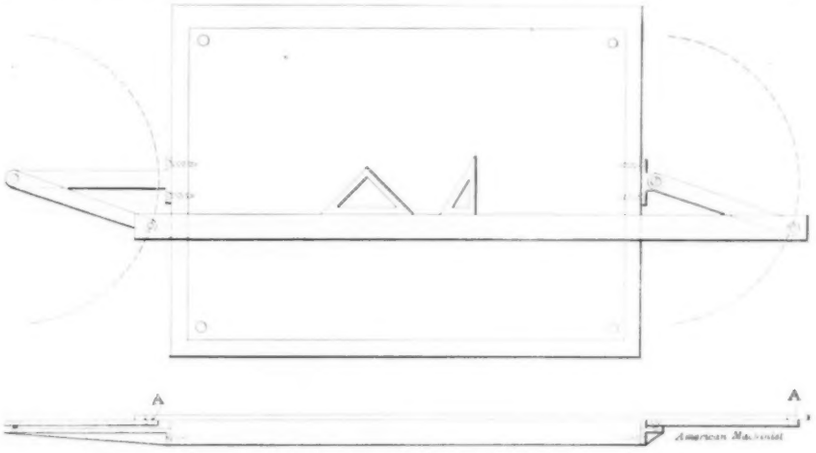
I wish to call the reader's attention to a part in the design that I bumped up against and which gave me much trouble. I made the outside of the stripper nearly the same diameter as the die, which necessitated a large recess in *I*, thereby reducing the support under die *C* and casting *D*, causing *D* to bind in and prevent E from working freely. Another important point is the rounding and polishing of the inside corners of the stripper after splitting; if not rounded marks will show in the finished shell. The die is secured to the press bed by bolts passing through holes drilled in *D* and *I*. The punch for the third and fourth operations, owing to its small diameter, is made from one piece of steel. In the punch for the first and second operations, the diameter is much larger and it would require a much larger piece of steel, costing more to make and to replace when worn.

G. D.

A Parallel Motion Straight-Edge for the Drawing Board.

Editor American Machinist:

I enclose a sketch of an arrangement for a parallel moving straight-edge, which consists of an ordinary drawing board with brackets on each end. The blade is connected with these brackets by links,



A PARALLEL MOTION STRAIGHT-EDGE.

which cause the ends of the blade to follow in the path indicated by the dotted lines and to remain parallel.

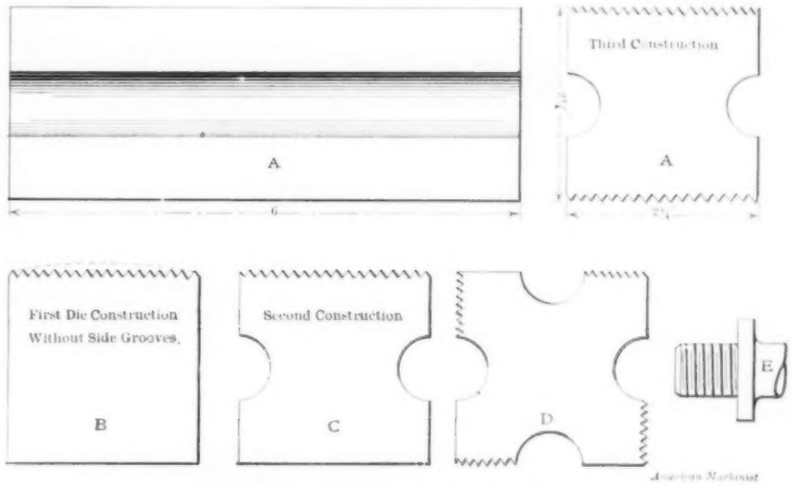
C. W. PUTNAM.

Experience With Thread Rolling Dies.

Editor American Machinist:

The sketch shows a die for rolling threads. The first few dies I made were like *B*, with one cutting face, and I found on testing after hardening that the cutting face was convex, as shown, exaggerated, in the dotted line, at least 1-100 inch. This may appear a small thing to kick about, but it was sufficient to spoil the thread. The threads are cut 24 per inch and 1-100 inch convex in the die makes 2-100 inch concave, or smaller, in the center of the thread than at the ends, and a nut fitting right at the end will shake at the center. To overcome the trouble in the die I finally cut threads on opposite faces, and with grooves, as shown at *A*, I got a practically perfect die and at the same time two dies in one block of steel.

Some of my mechanical friends had doubts as to the clamping on the toothed faces, saying that the dies would move and cut grooves in the clamping jaws in the machine. This was not the case, as the clamping surface is much larger than the points of contact on the stock, so that there is no danger of the dies moving while doing the rolling. *D* shows another way to make a die for the same purpose with four cutting faces on one steel block *for stock threaded short*. The reader may ask, "Why do you not cut on both sides of the groove and have eight cutting faces on one block?" The die *D* is for cutting threads on stock with shoulder, at *E*. A die with eight cutting faces would be useless for this class of work, as the corner threads would not be perfect, and when hardened would break off, but where the thread ends about ⅛ inch from the shoulder the die can be made with eight cutting faces by rounding the corners. It



PROGRESSIVE IMPROVEMENT OF ROLLING DIES.

should be noted that in *D* the metal is equally distributed, causing an equal expansion and contraction in hardening.

G. D.

The Photographing of Drawings.

Editor American Machinist:

I note at page 559 a reference made by Charles Nussbaum to an article by me in Vol. 24, at page 1109, in which he says he has never been able to find a plate slow enough to expose four minutes on a drawing. If he will refer to the article again he will see that I used a plate called Carbutt's Keystone B, which is a very slow plate and a very nice plate for taking machinery. In addition to the fact that the plate was slow, he will also notice that I mentioned that I used a single achromatic lens, which, of course, is much slower than the double rectilinear lens, which I presume he is using.

Regarding his reference to the cost in time and money being considerable, I do not think that it is enough to be prohibitive. Of course, I appreciate the fact that it is well to have the files of the AMERICAN MACHINIST at hand and completely indexed, but this is not always possible and in my own case I keep the files at my home. Frequently I wish to refer to something of this kind and if I have it in my card index, complete in itself, it saves time and unnecessary delay and I have not as yet found it too expensive to use the photographs in the few cases where it is justified. I do not mean that I would use it for indexing every article which appeared interesting to me, but for such articles as would be apt to come up for use in the course of my daily work.

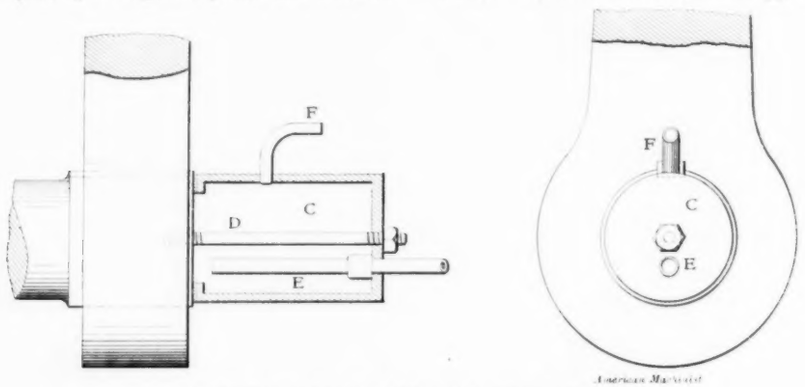
H. D. VAN DOORN.

Removing Large Cranks From Their Shafts.

Editor American Machinist:

Large steam-engine cranks sometimes have to be removed from their shafts while the latter are in their places. When tackled properly this job is not such a task as it appears to be, although it requires the exercise of a certain amount of care and judgment. The cranks are, as a rule, shrunk on, and therefore have to be heated to expand the bore to take them off. I have used various ways of heating them, according to the situations in which they are placed, sometimes using a specially constructed portable forge and sometimes powerful gas heaters and a portable blower. When the crank is being heated, however, the shaft must be kept as cool as possible to keep it from expanding also. The accompanying sketch shows how we effect this by a water jacket, which is a cylindrical pipe with a blank end cast on, the other end having a flange about 1½ inches broad, faced true to fit against the shaft end, the joint being made by an asbestos washer. *C* shows the water jacket in section, held to the shaft end by a bolt *D* passing through the jacket and screwed into the center of shaft end. *E* is the inlet pipe for cold water—coupled to the town supply. This pipe carries cold water to the shaft end as shown, and it circulates away through the pipe *F* at the top. When the crank is expanded enough, the water is let out of the jacket by a small cock at the bottom, not shown; the bolt is slackened, the jacket taken off and the crank pulled off, being slung in pulley-blocks.

W. D.



REMOVING LARGE CRANKS FROM THEIR SHAFTS.

Perishable Materials.

Editor American Machinist:

A man in the West has recently been writing to me about the placing of a monument in a cemetery. He is objecting to the use of marble because it is so perishable, and suggests aluminum instead, "because, you know that is not affected by the weather or anything else, and will last forever." I very decidedly did not fall in with his aluminum idea, because I wanted the assurance of someone better informed than he, a farmer, possibly could be about the eternal endurance of the metal of the moderns. I am beginning to hear many stories that lead me to doubt about the lasting qualities of the metal. I am not running down the metal. I appreciate the fact that it is one of the modern prizes, one of the metals precious to the worker for its utility and adaptability; but I do not think that it is going to distinguish itself above all the others for its lasting qualities. Of course it has its peculiarities and its own way of taking itself off, but its way is likely to be quite as effective as any of the old ways. They are telling me that the alloys of aluminum (and there is no pure commercial aluminum) crystalize or get brittle and break or crumble easily before they get very old, so that there is little promise of its outlasting marble in the long run. It would be very unpleasant for me to have my memorial stone made of some brittle material and then have it broken up so that they would get my name wrong if they should try to put it together again with some of the letters missing. Think of TECUMSEH SWIFT transformed into TEC SEH SWI. They would think that I was some old Chinaman.

Now, if my farmer friend had suggested galvanized iron for the tombstone, we would both have known more of what we were talking about. Galvanized iron is a combination in which the manufacturer has done his best to produce something imperishable. Iron soon rusts away, but the "galvanizing" prevents the rust, and there you are. Well, I know rows of houses in upper New York City built within the last twelve years which have galvanized iron cornices of various shapes, thoroughly painted over the zinc, and now they are in a most disgracefully dilapidated condition, many pieces having actually tumbled away and others being ready to fall. Galvanized iron is a very poor substitute for stone, and a very discouraging example of our modern preservative devices.

The other day I struck one of the greatest bargains of my life. I bought a leather covered edition of the Arabian Nights, a hundred years old, with pictures and double as much reading as they give in the modern editions, all for ten cents. The leather binding is still in good condition, without any cracks or giving out of the joints. I have a Webster's dictionary fifteen years old, leather bound, that is tumbling all to pieces, and not from excessive use either, but the leather seems to be affected with dry rot, so that it soon will be all crumbled away. Its condition has changed just as years ago I used to see belts change which ran in a dry, smoky atmosphere up near the ceiling. I used to handle some of that belting that deteriorated so rapidly that after three or four years it would be perfectly rotten, and I have sometimes torn a piece of 4-inch belt right in two with my hands. It used to turn red all through and get brittle and crumbly. I see that the librarians are beginning to object to leather bindings, which were once considered the most durable of all, and are recommending canvas or Turkey Morocco.

The unreliability, the perishability, of modern materials we encounter in every direction. Our paper is about as bad as anything we have to do with. It doesn't last; which must be very discouraging to a writer. No immortal words can now be written for our modern means of recording will not preserve or perpetuate them. I suppose no one will be reading the words of Tecumseh a thousand years from now, for the simple reason that the paper will have turned black or have gone to pieces and the ink will be illegible. That may not make so much difference, but the fading of the colors of a painting is a cruel thing. Think of a landscape of Turner.

"Sunshine painted with a squirt,
Foreground an ounce of golden dirt,"

with the sunshine and the gold all vanished and the $20,000 or so paid just for the name.

There must be something wrong and not easily accounted for in our modern methods to make them so productive of the perishable. Certainly perishability can never be purposed by the manufactureer, and yet it might as well be. The ancients had no better, nor as good, means of knowing what methods or materials would produce the perishable or the lasting, yet almost invariably their results were more enduring. Why should the leather produced a hundred years ago be in better condition to-day than that produced a dozen years ago? The librarians' preference for Turkish morocco as an enduring material is suggestive. That we may assume is produced by time tried and time honored methods, which sufficiently, in our present view of it, accounts for its endurance. If Turkish morocco was first produced in the present century, the twentieth, we would be justified in refusing it for the purposes for which it is now most strongly recommended.

In the case of paper we know very well why it is now more perishable and we know precisely how to avoid it. Wood pulp is very different material from cotton or linen, and if we use it we do it knowingly, to our present apparent gain,

but to unmitigated loss in the long run. The rusting of iron and steel is no new thing, but the general employment of it as a structural material is new and carries with it the assurance that we are not building for all time, but only for a day. Perhaps it is as well, for the fashion of our building changes and rapid deterioration gives us an excuse for reconstruction.

I wonder how much of Uncle Sam's good money goes away in rust. That spent for building ships of war must largely go in that direction. The life of a warship is, I believe, only ten or a dozen years, or say a third of a generation, while two or three generations may be expected to pass away without any real fighting, so that we build many more to rust than to fight. What will there be to show to posterity, say a couple of hundred years, or a thousand years from now, of one of our splendid ships of to-day, that cost throughout, five or more times as much per pound as Corliss engines? It would be a good scheme to embed a typical ship of the day in cement and fill the inside solid with cement and cover over the top with more cement. If it is a good thing to provide reliable historical material, and if we owe any duty to posterity, we could then flatter ourselves that we had actually done some good with one of our ships.

TECUMSEH SWIFT.

Annealing Self-Hardening Steel.

Editor American Machinist:

Machinists in general take it for granted that self-hardening steel cannot be annealed, and, consequently, do not try to anneal it. If they had been placed in a position, as I have been, where something of the kind had to be done, they possibly would have gotten the same results.

After repeated and discouraging trials with different makes of tool steel, on a very particular job, without getting the desired results, as the speed of the machine caused such a constant friction that it drew the temper of the dies, the thought struck me that if ordinary self-hardening steel could be annealed, I would be able to get what was wanted. I made inquiries, without any satisfaction to myself, and then started in on a little idea of my own. I tool an old planer tool of self-hardening steel, heated it, and cut off the length I wanted. Reasoning that if it would harden in the air, keeping air from it would naturally soften it, I prepared a piece of 1½-inch pipe, 8 inches long, with caps to screw on both ends. I filled the pipe with steel and white sand and screwed on both caps, using a paste made of fire clay and water, applied to outside of caps, where they joined the pipe, in order to exclude all air. I put the pipe in the fire, heating it thoroughly, a little hotter than ordinary annealing requires, banked the fire, and left it to cool off. Removing the pipe, I took off the caps, and to my surprise found the steel was soft enough to drill, mill or file. I sawed it down through the center and made it into dies, hardened them, and tried one in the machine. The result was so satisfactory that I had an annealing box made, ordered steel nearer the size, and for two years have had no trouble with the machines. The annealing box was made just large enough to go into a small gas muffle whose cover overlapped the sides and ends, sand and clay being used as before. I start up the gas muffle, heating box and all, to a very good heat, turn off the muffle, close up the vent holes with fire-clay and leave the box to cool. The result is even better than with an open fire and pipe; so much so that we plane them up in gangs on a fast running planer right down to size, which must be to the thousandth.

G. K. STEVENSON.

[There may be some difference of opinion regarding the explanation of these results, but the results themselves will interest all.—Ed.]

An Open Letter on the Attitude of Certain Organizations on the Union Labor Question.

Echoes and re-echoes of Parry's presidential address at New Orleans continue to be heard, and the latest to reach us is in the form of an open letter written by E. F. Du Brul, as Commissioner of the National Metal Trades Association, to Ralph M. Easley, editor *Monthly Review*, National Civic Federation, in which letter Mr. Du Brul takes exception to certain statements and explains at some length the position of his own and other associations on the labor union question. The letter says:

"You state, regarding the National Association of Manufacturers, that the association endorsed statements made by its president in New Orleans. If you can find any endorsement of anybody's statements in the minutes of that convention you will do more than the official reporter can do himself, and all of the acts of that convention are on record in the minutes.

"Whatever may be Mr. Parry's personal opinions, and in whatever manner he may express them, the National Association of Manufacturers is on record with a declaration of principles and some resolutions, none of which are directed against the organization of labor as such. They are directed, and strongly so, against the vicious and lawless element in such organizations.

"The National Association of Manufacturers is not an organization of employers as such, and of itself does not touch the labor question, excepting as it is affected by legislation. On the other hand, the association, by its acts, insists that the vicious and lawless element should not be considered the true representatives of the great body of organized labor, and in denouncing the vicious and lawless element it cannot be considered as an attack on the organization of labor. Certainly you cannot believe that the vicious and lawless are an essential part of the organization of labor. Why, therefore, put yourself in the position of seeming to believe it by taking as gospel truth the garbled press reports of a convention representing two thousand patriotic manufacturers, who specifically went on record in these particulars?

"Regarding the Employers' Association of Dayton and kindred organizations, here again, whatever may be the personal opinions of the president of that organization, you are wrong in assuming that it was organized for the specific purpose of smashing unions. If you will take the slight trouble to read the constitution of that organization you will see just why it was brought into being.

"Now, regarding the National Metal Trades Association, of which I have the honor to be Commissioner, I beg to deny your statement that this organization is more or less hostile to the organization of labor. This organization is absolutely hostile to illegal acts, whether performed by workmen or employers, organized or unorganized. Because we do not choose to make agreements with certain unions you seem to consider us hostile to their existence.

"We had an experience that has made us chary of the present management of the Machinists' Union. Perhaps we are wrong in our position in this regard, but in a number of cases of recent date, in attempting to deal with the Machinists' Union in various localities, we have found that it was impossible to do business with them. At this writing, in Rochester, N. Y., there is a strike on in a member's shop:* a strike that seems to have been voted against the wishes of the employees of that shop by the employees of other shops. The strike is an effort to compel the company to abolish the premium system, and so reduce the earnings of their men. The premium system has been in operation for two years to the great satisfaction not only of the company, but also of its employees. In that case the official representatives of the Machinists' Union of Rochester absolutely refused to submit the matters in dispute to a disinterested Board of Conciliation."

After mentioning other difficulties that seem impossible to settle amicably, the letter says:

"On the other hand, conferences are now going on in Pittsburgh, St. Louis and Chicago without strikes, which, it is hoped and believed, will result in amicable and equitable settlements.

"These things are not theories, but they are facts, and the natural feeling among the members of the National Metal Trades Association is that, until we have evidence that the management of the Machinists' Union shows itself, by its acts,

*This, we believe, is the shop of W. P. Davis & Co.—Ed.

to be such as the members of this association can place confidence in, we had better not have another national agreement. On the other hand, this association is definitely on record as permitting agreements between its members and their employers, collectively, whenever the members feel that the collective management of their employees' affairs is business-like and reasonable.

"Now, referring to our periodical. It has been my aim and intention in publishing our monthly 'Bulletin' not to devote it to attacks on organized labor, but to devote it to denouncements of the evils that are now so prevalent with organized labor, and which I firmly believe can be removed only by an awakening of public sentiment. If you had read our 'Bulletin' as carefully as I shall read your publication you would see in every number articles dealing with the problems of conciliation and arbitration. In the very first number, July, 1902, there was an exposition of the satisfactory settlement of machinist matters in St. Louis last year."

Then follows a list of articles of similar import that have been published from time to time, and regarding these the letter says:

"Now, if the printing of articles of that sort, together with other articles that condemned the vicious practices of some unionists, are attacks on organized labor, I suppose that we are guilty.

"I believe, with you, that 'there is a common ground where employer and employee can meet with satisfaction and honor to each,' and wherever, in my work as Commissioner of this association, I find that a union involved with us is willing to deal fairly, I recommend as strongly as lies within my power that the employees be met more than half way. In Cincinnati prominent members of the National Metal Trades Association, imbued with the idea of fair dealing and conciliation, after having fought through a bitter strike two years ago, which would never have occurred had the machinists' officials in this city and elsewhere not brought it about, have voluntarily and unasked consummated a reduction in the working time of the shops of the members here to fifty-five hours per week, with no reduction in pay.

"In Cincinnati and in other places the local secretaries act very largely in the capacity of joint 'social secretaries' for members, listening to complaints of the workmen, hearing their grievances and seeing to it that abuses unsuspected by the employers are corrected.

"I want to assure you, sir, that the membership of the National Metal Trades Association aims to deal fairly and justly by all of their employees, whether organized or unorganized. In this way we differ from others, but we take it that the Coal Strike Commission is, so far, the highest authority in these matters, and we accept their good American dictum that 'no discrimination shall be made against any employee because of his membership, or non-membership, in a labor organization,' and we stand ready to enforce in our shops their further dictum that 'no employee shall be discriminated against by the members of a labor organization because of his non-membership in such organization.' If this is hostility to the organization of labor, then this association is not as hostile to organized labor as that commission, for we can never use language as strong as that commission's report.

"Even during the heat of the general machinists' strike of two years ago, when we adopted our present declaration of principles (every one of which has since been practically sustained in the coal strike report), this organization there went on record as favoring conciliation between employers and employees in the following words: 'In cases of disagreement concerning matters not covered by the foregoing declaration, we advise our members to meet their employees either individually or collectively, and endeavor to adjust the difficulties on a fair and equitable basis. In case of inability to reach a satisfactory adjustment, we advise that they submit the question to arbitration by a board composed of six persons, three to be chosen by the employee or employees. In order to receive the benefits of the arbitration the employee or employees must continue in service and under the orders of the employer pending a decision. In case any member refuses to comply with this recommendation he shall be denied the support of this association until it shall approve the action of said member.' I wish to say further that in no case has a member received support in which he did not endeavor to adjust his difficulties as above.

"Now, Mr. Easley, do you think it fair to confound our hostility to illegal and unjust acts, with hostility to the principle of organization, a principle which we ourselves are daily preaching to the employers?"

Varnish Before the Mechanical Engineers—The New Engineers' Building.

A large number of the local membership of the American Society of Mechanical Engineers are the poorer in not having attended the last monthly meeting of the season at the house of the society on the evening of May 5. The announced topic was "The Technology of Artistic and Industrial Painting," and the speaker of the evening was Prof. A. H. Sabin, a member of the society. A better title for Professor Sabin's talk would have been paint, oil and varnish, or even varnish alone, and this without the slightest derogatory suggestion. The speaker proved himself not only an expert full of special technical information, with facility in imparting the same, but a man of wide general knowledge, a man of large caliber, and we could not but think, to speak plainly, that it savored of imposition to ask such a man to waste his time and valuable discourse before "a beggarly account of empty benches."

Oil paints are comparatively modern even for the purposes of the artist. They are used because of the facility with which they can be applied, rather than for their intrinsic value, the earlier painters having used varnishes and earlier than that water colors. The peculiar action and properties of linseed oil were explained by the speaker. It hardens by oxidation instead of by evaporation, and when fully hardened is always more or less porous on account of its final shrinkages. Varnish is apparently more desirable in every way, both for covering and for decoration. The process of varnish making was quite minutely described. Age seems to be an important feature in the resins employed for the best varnishes. Those from Africa or from the shores of the Baltic are so old that the trees which produced them are now extinct, and they often enclose insects of species no longer known to man. In the commercial manufacture of varnish a hundredweight or so is heated in an iron vessel over a coke fire, the temperature of the material being carried up to 700 or even 800 degrees Fahr., and while heated it is constantly stirred with an iron rod passed through a hole in the cover of the vessel. The stirring is continued until all the lumps have disappeared, and oil is then added in different proportions, according to the purposes for which the varnish is used. This mixture is kept hot and stirred for a long time, all the details of the operations varying with the precise materials and uses of the varnish. After describing the processes minutely and indicating the essential conditions to meet different requirements, the speaker read a translation from an old Latin writer describing in detail the making of varnish, and the close resemblance to the modern way was most remarkable. The Egyptians also practiced the art of varnish making, and theirs also was very similar to the modern varnish in material and process. The varnishes of the ancients were not spread with a brush but usually with a spatula, or even were laid on and smoothed with the fingers. Some of the outer cases of the mummies in the Metropolitan Museum of Art have a perfect varnish upon them, practically identical with some of those now produced. The lecture was closed with a neat sketch of the derivation of the word "varnish." A beautiful Egyptian queen, Berenice, for the safe return of her husband, dedicated her golden hair in the temple of Arsinoë, and when it had disappeared from the altar a learned astronomer reported it transformed into the constellation Coma Berenices. The yellow hair of Berenice became a tradition, and when certain voyagers found on the shores of the Baltic the hitherto unknown amber, they called

that berenice, and the name clung to the material through its transformations and adaptations. The Spanish name for varnish to this day is berniz, which directly shows the relationship. In assimilating the word in other languages the "b" was changed to "v," and the other changes of spelling or pronunciation to our present word varnish easily followed. The address was highly appreciated by those who heard it, and perhaps still more interesting and instructive was the answering of questions and the interchange of varnish experiences. It came out, for instance, that there is really no such thing as copal varnish, the word copal being a generic term, just as the word metal is. So-called copal varnishes are of various composition and a constituent frequently found in them is common rosin.

It was scarcely possible to close the meeting without something being said about the gift of Andrew Carnegie, President Dodge and Secretary Hutton being of course full of it. Mr. Dodge spoke of the remarkable little bit of paper which was handed around at a meeting of representatives of the four national engineering societies and of the Engineers' Club. This bit of paper, after the formal enumeration of the titles in full of the several bodies addressed, contained but a single sentence:

"It will give me great pleasure to give, say, $1,000,000 to erect a suitable union building for you all, as the same may be needed. ANDREW CARNEGIE."

This sentence could scarcely have been taken seriously with any other name in the world subscribed to it, but the one name carried full assurance. Mr. Dodge explained Mr. Carnegie's intention somewhat more fully, but it really added little. The gift is entirely unconditional, and the confidence in the wisdom of the societies to best secure their own best interests is unbounded. The wish is that each society shall have for itself just what it needs and that the things that all use in common shall be what will be most satisfactory for all. It is not at all suggested that there shall be any equal or formal apportionment to each body, as it is understood from the first that they are not precisely alike in their needs. There is no suggestion that Mr. Carnegie's name is to be given to the building or in any way permanently connected with it. The matter had come up only quite recently and had come to a happy conclusion almost suddenly. The details of the scheme are to be carried along as rapidly as possible. A meeting of the joint committees had been appointed for May 7, and immediately after that it was expected that formal announcements would be sent out to all the members for suggestion and consent.

Suit Against a Monopoly.

We have previously referred to the high-handed action of the shoe machine trust and the measures it takes, not merely to compete with smaller builders, but to shut them out of the market entirely and ruin them. This attitude has resulted in suit being brought against them in Boston by a manufacturer. He sues for $1,000,000 damages, claiming that his business as a manufacturer of shoe machinery, in which business he has about $300,000 invested, has been destroyed, and his property rendered useless by wrongful and illegal acts of the United States Shoe Machinery Company—the trust. Suit is brought in the United States Court under an act entitled, "an act to protect trade and commerce against unlawful restraints and monopolies."

Iron for Piston Rings.

"Automobile" asks for a good mixture of iron for casting piston rings in small sizes. This question was referred to our contributor, R. H. Palmer, whose reply will answer also another questioner, who asks whether piston rings should be harder or softer than the cylinder in which they are to run. Mr. Palmer says:

"In mixing irons for making castings for piston packing or rings it is well to keep in mind that a hard packing will cut a cylinder. Hence a soft iron is necessary. Also, graphite is a lubricator; so a soft iron rich in graphitic carbon is preferred. The above is the principle I have worked on, and so far have had no cause to regret it."

The Wisdom Calendar.

The Pratt & Whitney Company, of Hartford, are sending out a calendar, which begins with May 1 and on each daily leaf of which is a quotation from the now famous book "Letters From a Self-Made Merchant to His Son," by George Horace Lorimer. The reading of one of these extracts each day ought to be good mental exercise and to stimulate the reading of the book—and that will be a good thing. The chunk of wisdom for May 1 is: "Some men learn the value of truth by having to do business with liars; and some by going to Sunday school." That for May 6 is: "Some men get an education from other men and newspapers and public libraries; and some get it from professors and parchments—it doesn't make any special difference how you get a 'half-nelson' on the right thing, just so you get it and freeze on to it."

It is stated that sixty yacht engines, costing $1,000 each, for which the navy had no immediate use, were recently built at the New York Navy Yard merely to keep the machinists together and employed until the building of the new warship could be commenced. It was thought that the cost of reorganizing the department and of hiring and breaking in new men when wanted would have been greater than the cost of keeping the old force employed upon comparatively useless work. It is not to be supposed that any portion of the cost of these yacht engines will appear in the cost of the warship, but in a private yard it would certainly appear somewhere in the ultimate profit and loss. The average shop proprietor will wonder whether some tools or other shop appliances which would have been certainly serviceable could not have been built. It would be an exceptional shop manager, outside of the government service, who could not find a plenty of work for increasing the shop facilities if, as in this case, he had an opportunity to employ his men for their production.

A movement is on foot in England for the erection of a monument to John Kay, the inventor of the "fly shuttle." In every loom before his time the shuttle was passed or thrown through the warp from one hand of the weaver to the other, while in weaving wide fabrics two weavers were required. Kay's invention at once quadrupled the effective work of the weaver, and its introduction met great opposition. A mob broke into his house and destroyed everything they could find, and he barely escaped with his life. His father was a well-to-do manufacturer, but the son died in poverty and obscurity in France, and the location of his grave is unknown. Nevertheless, he was one of those who inaugurated the great industrial revolution which changed the world from the manual to the mechanical system of labor, and his name deserves perpetuation.

The latest name of the oil swindlers in Cleveland is the "Osborn Oil Company," and their letter-head contains an attractive picture which suggests some of the photographs we have received from our friend Osborn, who writes "Echoes From the Oil Country." It is hardly necessary to say, however, that he is not connected with this oil concern in Cleveland, which has the usual proposition to make of a low price on the oil because it is already in the vicinity of the prospective victim and they do not wish to ship it back.

Sixteen stockless anchors weighing 16,500 pounds each and six others weighing 13,000 pounds each are being built at Chester, Pa., for the United States Navy. The old anchor, so useful as a symbol or for decorative purposes, is rapidly being robbed of its significance as suggested by familiarity. It is about time to drop the use of "red-tape" in our talk, as no one sees it any more. In the courts the law papers are all held by rubber bands.

The newspapers are telling of a toolmaker, Joseph Piper, of Hamilton, Ohio, who announces a marvelous new process of tempering steel. In an exhibition recently given by him, he is said to have exhibited a razor tempered by his process which he used satisfactorily for shaving after cutting off pieces of nails with it.

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Of this issue of the AMERICAN MACHINIST *17,550 copies are printed. Total for 1903, so far, 409,350. None sent regularly free. None taken back from news-stands. No back numbers beyond current year.*

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The Union Engineering Building.

Since our last issue went to press we have received a copy of a pamphlet which gives in full the plan of Mr. Carnegie for providing a union building for the various engineering societies and the Engineers' Club. The first reports were somewhat contradictory, some having it that Mr. Carnegie was merely to provide the capital for the Engineers' Realty Corporation, which should build the house and then rent it to the various organizations, while other reports stated the case as a gift outright. The latter proves to be the fact, so far as the building is concerned, though the various organizations are to buy the ground.

The Engineers' Realty Corporation had already acquired two lots having a combined frontage of 50 feet on the south side of Fortieth street, overlooking the new public library site, and options have since been secured on five additional lots, aggregating 125 feet in frontage, on the north side of Thirty-ninth street, the two plots abutting in the rear. On the former the club house will be erected, and on the latter the building for the societies. The latter will contain a large auditorium and several smaller ones, a library, which we hope will in effect be a union library, though with individual ownership of the books, and suits of offices for the various societies. The plan is thus exactly the one which has been outlined in these columns in the past, although it is upon a far larger scale than we had ever dreamed would be possible.

Mr. Carnegie's letter is addressed to the Civil, Mechanical, Mining and Electrical Engineering Societies and to the Engineers' Club. It reads simply:

"It will give me great pleasure to give, say, one million dollars to erect a suitable union building for you all as the same may be needed."

This, it will be seen, imposes no conditions unless the words "for you all" are intended to mean for all or none—in other words, that all the societies named must come into the circle. In that case there may be a hitch. The Civil Engineers already own a fine building in Fifty-seventh street, which was erected especially for them and which they may prefer not to leave, even should it be salable, which, in view of its character, may be doubtful. The Mining Engineers have no headquarters but a secretary's office, and have always preferred that plan, fearing that a different policy would tend to localize the organization and prevent its being truly national.

The other organizations are ripe for the change. The house of the Mechanical Engineers is too small and is altogether inadequate for the only occasions when it is really used by the society at large—the annual meetings—and it has come to be clearly recognized that some change must be made in the near future. The Electrical Engineers for some years have been trying in vain to raise the money wherewith to house their splendid library and are, no doubt, ready to accept help. The Engineers' Club has also been trying to finance a new club house through the creation of the Engineers' Realty Corporation and has not, we believe, made flattering progress.

So far as these societies are concerned the conditions are very opportune, although even for them the case is not one of clear sailing, and it is still less so for the Civil and Mining Engineers. The fact that the societies are expected to buy the land places serious obstacles in the way of the enterprise, as the interest charge on the purchase money will be so great as to increase their running expenses by a serious amount. The Mechanical Engineers are in the best position of all, as they have a considerable equity in their house, based on the original purchase price, and it is well known that the property is not only salable but that a handsome profit can be realized over its original cost.

The Mining and Electrical Engineers must pay heavily for the rental of their present quarters, while both the Civil and Mechanical Engineers have a considerable annual charge for the interest on mortgages on their premises. The savings due to wiping out these annual charges will partially offset the new charges which they must assume, though there will still be left a considerable balance of additional expenses.

We have faith to believe that a way will be found to overcome these difficulties, though it would be idle to deny that they exist and that they are serious.

While the societies which we have named are the only ones which are at present embraced in the enterprise, it is intended that the building shall be fitted to accommodate others as well. The Society of Naval Architects and Marine Engineers and the New York Railroad Club should obviously come within the circle, and probably also the Society of Heating and Ventilating Engineers.

The influence which Mr. Carnegie's gift will have upon engineering and upon the membership and prosperity of the societies is beyond estimate, and is not to be measured by dollars nor by millions of them. It is by far the most creditable and appropriate thing of the kind which he has done.

Hail to the star-spangled Scotchman!

The Report of a Committee of the American Society of Mechanical Engineers on the Metric System.

The report of the committee appointed by the above named society to consider the metric system has been sent out to the membership with a request for an expression of opinion on a series of questions.

The report, together with its appendices, the paper of Mr. Halsey and the discus-

sion thereon, constitutes a very complete treatment of the subject—so complete, we fear, that not many will feel inclined to wade through it all. The report, in fact, seems to be afflicted with appendicitis, and the removal of a good share of the appendices at least would be an improvement to it.

The committee, which is composed of James Christie, of the Pencoyd Iron Works, chairman; Geo. M. Bond, William Kent and Fred J. Miller, found themselves able to agree on the following points:

1. Legislation designed to compel the exclusive use of the metric system is not desirable.

2. We believe that such legislation could not be enforced in any event, so far as transactions between private individuals are concerned.

3. The general government has the power to specify the system to be used in its own work and business, and can require that work done for it by contractors shall conform to any specified measurements or weights.

4. The government cannot compel anyone to bid upon its specifications.

5. Recognizing the well settled fact that the consumer does and must pay all necessary costs of production, we believe that if the government specifies such dimensions as will materially increase costs of production, the government and not the bidder will have to pay such increased costs, it being self-evident that a bidder, not compelled to bid, will not bid except at a price which will afford him a profit.

6. The bill now before Congress is intended to make the use of the metric system compulsory in the several departments of the government, but it cannot make it compulsory in private transactions.

7. We believe there is no force in that class of arguments which consists in taking integral dimensions in one system, translating them into equivalent and therefore fractional dimensions in the other system and then making comparisons. Such arguments can be made as strong for the one system as for the other.

All four members of the committee sign this much of the report, but on pretty much all other points they do not agree, and Messrs. Christie and Miller on one side and Bond and Kent on the other present the respective arguments, *pro* and *con*. Some of these arguments do not seem to be consistent with the points agreed to. For instance, taking points 3, 4, 5 and 6 together, it is clear that they mean, if they mean anything, that all the members of the committee believe that no manufacturer doing work for the government after the proposed law, or any other possible law, may be in force, would be put to any expense not fully paid for by his customer—*i. e.*, the government. And yet certain appendices to this report seem to be inserted for the purpose of giving the impression that manufacturers will suffer hardships if the proposed law is passed. In due course the vote of the members will be recorded, and after that is done those who believe in the superiority of the metric system and that we should be better off if we were to adopt it, will no doubt go on working for its adoption as before, while those who believe the contrary, together with those who have not and will not take the trouble to investigate the matter, and whose inertia must be overcome before any change of this nature can be made, will oppose it. In the end, as we have often said before, the metric system will come into use by gradual steps in that direction, each step being taken because it is in one way or another advantageous to the person taking it.

Commercial "War."

At the annual dinner of the Iron and Steel Institute of Great Britain, at which Andrew Carnegie was especially honored, Premier Balfour uttered sentiments which will, we think, meet with a hearty response from people who are in the habit of taking a broad view of things and of looking a little below the surface. The cable dispatches credit him with saying that he distrusted profoundly the current creed that the prosperity of one nation meant the adversity of another. Commercial rivalry and collision of interests between employer and employed were absolutely insignificant, he said, when compared to the great community of interests in production and scientific research, in which these rivalries ought to be lost and forgotten. Industry should be regarded as an international affair, not as international rivalry, but as international friendship. The more they could bring themselves to regard industry in that light the more he was convinced each individual community in the country would be prosperous.

We have always deprecated the militant view of international trade and the talk of "commercial invasions," industries "driven to the wall," "desperate struggles for supremacy," etc., as though no goods could possibly be sent from one country to another in answer to the demands of trade without injury to the country receiving them. We believe that cheap transportation by land and sea is a blessing, not a curse, and that international trade is the great civilizer and remover of international jealousies and misunderstandings. If we are to take the other view, then we must regard as enemies of humanity all those who are engaged in perfecting steamships and reducing the cost of ocean freights, and must place in the same category all those who send machinery abroad to be used there in the production of goods.

Report of the Mosley Industrial Commision.

We have received a copy of the report of the above named commission of workingmen's representatives, which, our readers will remember, made an extended tour through this country last fall. The report is very voluminous, comprising 279 8x10-inch pages. Each of the twenty-two members gives a general account of his observations and conclusions, with detailed replies to a fixed set of forty-one questions.

No adequate abstract of so large a report is possible in the space available in these columns. We should, however, remark that the cabled press despatches have shown their usual degree of accuracy in reporting the conclusions of at least one of the members, Mr. G. N. Barnes, of the Amalgamated Society of Engineers. These despatches stated that Mr. Barnes described the general industrial condition here as "hell with the lid off." The fact is that he repeated these time-worn words between quotation marks and in their original significance as descriptive of the smoky atmosphere of Pittsburgh.

In view of the general impression which prevails both here and abroad, the answers to question No. 5 are perhaps as interesting as any. This question reads: "Does the American workman do more or less in an hour on the average than the English workman?" The answers to this question (somewhat abbreviated in some cases) are as follows:

By P. Walls, of the National Federation of Blastfurnacemen: "We failed to find ocular evidence of the American workman running at high pressure. With better appliances the American does more."

By J. Maddison, of the Friendly Society of Ironfounders: "I have come to the conclusion that the American molder turns out something like 25 per cent. more work than the English molder. Ten per cent. may be said to be due to extra effort and the other 15 per cent. to better facilities."

By James Cox, of the Associated Iron and Steel Workers: "Greater productiveness with less physical exertion, consequent upon greater adaptability of machinery and labor-saving appliances."

By G. N. Barnes, of the Amalgamated Society of Engineers: "I should say that more work per hour is turned out, but there is a qualitative as well as a quantitative efficiency." In reply to another question Mr. Barnes said: "Greater output is, I believe, almost entirely due to more machinery compared with hand work."

By D. C. Cummings, of the Iron and Steel Shipbuilders' and Boiler Makers' Society: "I unhesitatingly say no."

By Alex. Wilkie, of the Associated Shipwrights' Society: "By those from whom we made inquiries, many of whom have worked both in this country and America, we were assured that they worked no harder in the American shipyards than they do in the British yards."

By Robert Holmshaw, of the Sheffield Cutlery Council: "The American workman does not actually work harder than

the English workman in an hour, yet his output in certain branches of the cutlery trade is greater, because of the improved conditions under which he works."

By T. Jones, of the Midland Counties Trades' Federation: "No comparison. They work under different conditions."

By T. Thomas Ashton, of the Operative Cotton Spinners: "My impression is that there is very little difference when they are employed under similar conditions."

By W. H. Wilkinson, of the Northern Counties Amalgamated Associations of Weavers: "I do not think there is much difference."

By W. B. Hornidge, of the National Union of Boot and Shoe Operatives: "Should say yes."

By G. T. Lapping, of the Amalgamated Society of Leather Workers: "The American workman produces more in an hour on the average."

By H. R. Taylor, of the Operative Bricklayers' Society: "More, but the work is of a different character, generally much rougher."

By M. Deller, of the National Association of Operative Plasterers: "The American workman in my trade undoubtedly covers more ground than we in England do, but the quality is very inferior."

By H. Crawford, of the General Union of Operative Carpenters and Joiners: "In every shop I went into the great majority of the men had worked in the old country, and their opinion was that they did not work so hard in America as in England."

By Harry Ham, of the National Amalgamated Furnishing Trades' Association: "More; but this is accounted for through the assistance of machinery."

By W. Dyson, of the Amalgamated Paper Makers' Union: "There is very little difference between the two countries. The working at high pressure and the everlasting hustle ascribed to American workshops is a myth and exists in imagination only."

By C. W. Bowerman, of the London Society of Compositors: "As a general rule they do not appear to work harder, if so hard, although the hours of labor are somewhat longer than those prevailing in this country."

By Geo. D. Kelley, of the Amalgamated Society of Lithographic Printers: He does little, if any, more, but he has greater facilities than are generally provided in this country."

By W. Coffey, of the London Consolidated Society of Journeymen Bookbinders: "I did not observe any evidence of the high pressure that is said to prevail in American workshops."

By W. C. Steadman, of the Parliamentary Committee of the Trades' Union Congress: "No."

Geo. W. Scott, consulting engineer, has removed his offices from "The Rookery" to 1301-2 Security Building, Chicago.

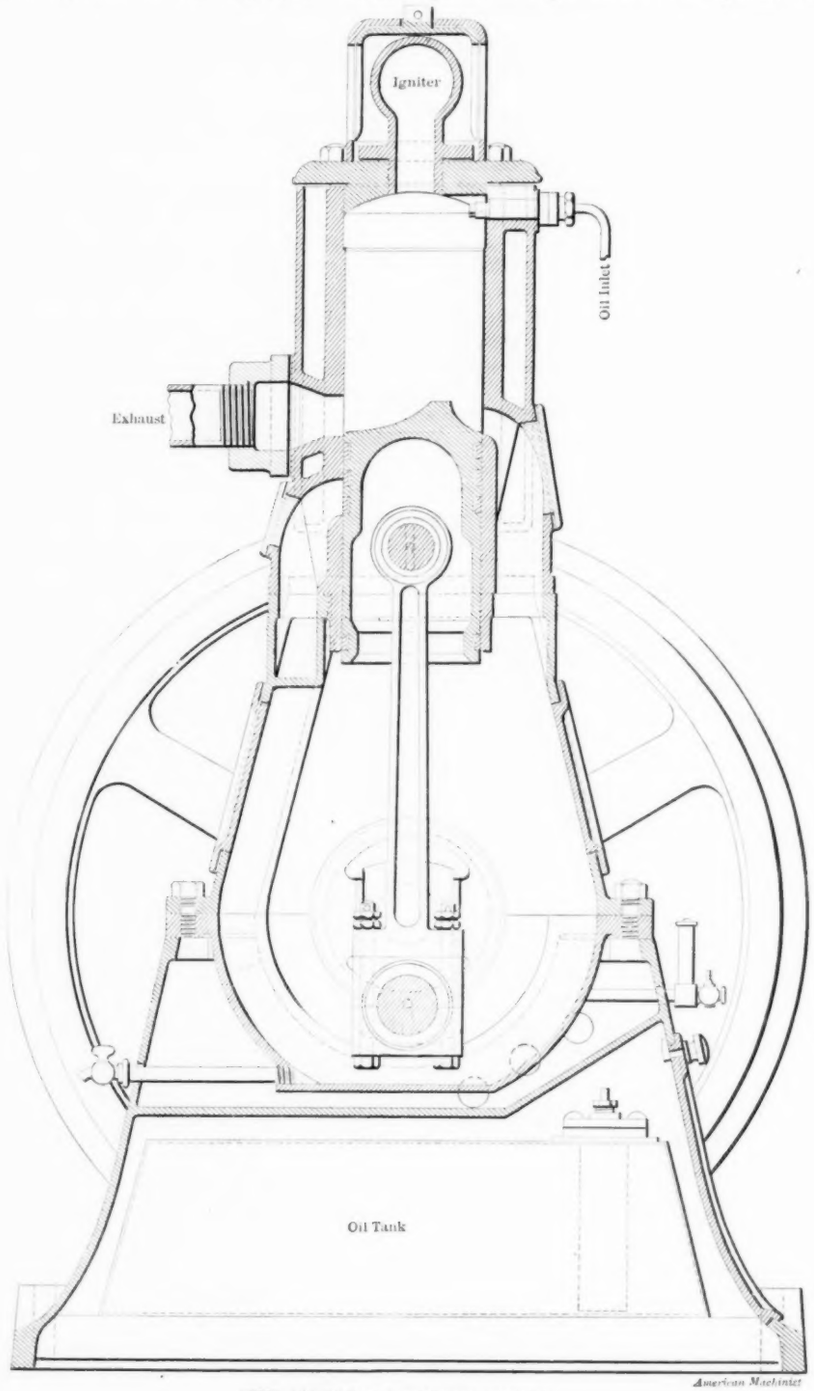
New Engineering Building for the University of Pennsylvania.

Plans have been drawn for a new Engineering Building which is to be erected by the University of Pennsylvania at Thirty-third and Locust streets, Philadelphia. The building is to be 160 by 300 feet, with a rear wing of 40 by 50 feet. It will be three stories high, with a basement, and will contain in the aggregate 128,000 square feet of floor space. It will contain cement testing, physical testing, hydraulic, mechanical, electrical and other laboratories, foundry, wood and iron working and forge shops, lecture, class and drawing rooms, library, museum, etc. It is to be ready for occupancy by the fall of 1904, and is expected to provide facilities which are equal to any in the country.

Some New Things.

THE AMERICAN KEROSENE ENGINE.

This is a vertical two-cycle engine, the general principle of whose operation requires no explanation. The cylinder being full of fresh air, as the piston rises this air is compressed and a charge of oil is sprayed into and mixed with it, and the charge is ignited by the heat of the igniter chamber above the cylinder head. There



THE AMERICAN KEROSENE ENGINE.

is no mixing of combustible with air until the ignition is intended to take place. The energy for the stroke being furnished by the combustion, the piston is driven through the return stroke, when the ports are uncovered and there is an escape of the products of combustion and a scavenging inrush of fresh air. There is a shaft governor which controls the throw of an eccentric which drives the oil pump, thus providing efficient regulation. A Primus kerosene torch is used for heating up when first starting, and a hand lever is provided for operating the oil pump to fill the delivery pipe. The exhaust of this engine is claimed to be odorless and invisible when running in normal good condition, and a muffler is provided to kill the noise of the exhaust. The Manhattan Transit Company, 250 East Forty-eighth street, New York City.

BLUEPRINT COPYING MACHINE.

The Pittsburg Blue Print Company has brought out a new automatic controller for their blueprinting machine, which has been illustrated in our columns. The lamp is now lowered and raised through the glass cylinder by a small electric motor, the lighting of the lamp, the speed, the reversal and the stopping of the motion and of the light being all automatic. The machine is also self-contained.

Technical Publications.

"British Standard Sections." Issued by the Engineering Standards Committee. Nine 8¼x15-inch pages. The D. Van Nostrand Company, New York. Price $1.00.

These tables are the result of the attempt which was inaugurated in England some time ago to standardize rolled sections of structural steel. The resulting standards are supported by the Institutes of Civil, Mechanical and Electrical Engineers and by the Institution of Naval Architects and the Iron and Steel Institute. The standardization of these sections has been long delayed in Great Britain to the considerable loss of British interests. The present standards have a formidable backing and should therefore become established in practice more rapidly than is commonly the case with such things.

"Experiments on the Flexure of Beams." By A. E. Guy. 122 5¾x8-inch pages, with 31 illustrations. The D. Van Nostrand Company, New York; Crosby, Lockwood & Son, London. Price $1.25.

This book is a republication of the articles by Mr. Guy which were first published in our columns during the early part of last year. It will be remembered that by an extended series of experiments the author had discovered the laws of failure of beams when so long as to give way by buckling after the manner of long columns. More than this, these laws were connected by a formula which showed that Euler's formula for long columns is in reality the fundamental formula for long beams as well as long columns, and the limiting proportions were determined within which beams fail as they are assumed to do by the usual formulas and beyond which they fail by buckling. We said at the time the articles were published that these results are nothing less than brilliant, and we repeat it now. They open a new chapter in the subject of the strength of beams, and the experiments will, we believe, come to be looked upon as classical. The interest taken in the experiments was indicated by the fact that our back numbers containing them were promptly exhausted, and it is this fact which has led to their republication in book form.

By action taken at the Milwaukee meeting of the International Association of Machinists practically all employees of a machine shop may now become members of the association. Heretofore only skilled men could belong—men who were considered to be competent machinists.

At the Milwaukee meeting of the International Association of Machinists a man named Seigle, who was a delegate from New York, was charged with being a spy in the employ of the National Metal Trades Association, and is reported to have made a confession to that effect.

Personal.

Mr. Miner left on the "New York," on May 6, to enter the employ of Schuchardt & Schütte, as a demonstrator of Landis grinders.

Charles Kirchoff, editor of the *Iron Age*, will present a paper before the Franklin Institute of Philadelphia Thursday evening, May 14, at 8 P. M. on "The Utilization of Blast Furnace Gases for Power Purposes."

Edward Huber has withdrawn from the firm of McCrosky & Huber, of Cincinnati, manufacturers of adjustable reamers, with which he has been connected for the past three years, and has taken a position as assistant superintendent in charge of the night force at the electrical establishment of the Bullock Electric Manufacturing Company, Cincinnati. Before entering the above firm Mr. Huber was for several years associated with the Bullock company.

It is announced that William Kent has been appointed Dean of the L. C. Smith College of Applied Science, of Syracuse University. Mr. Kent was born in Philadelphia and is a graduate of Stevens Institute of Technology. He was editor of the *American Manufacturer and Iron World* 1877 to 1879, has been mechanical engineer and superintendent in various iron, steel and boiler concerns, and an independent consulting engineer. Since 1895 he has been associate editor of *Engineering News*. He is a member of the American Institute of Mining Engineers, American Society of Mechanical Engineers, and has been a prolific contributor to their transactions. He is the author of various works, including "Strength of Materials," "Strength of Wrought Iron and Chain Cables" and "Kent's Engineer's Pocket-Book."

Commercial Review.

NEW YORK, Monday, May 11, 1903.

Manufacturers of machinery are indulging in considerable speculation nowadays as to the prospects of trade during the coming summer. As might naturally be expected, the spirit of hopefulness pervading the trade is of the most pronounced kind, although here and there a machinery merchant can be found who doesn't view the outlook through such rose-colored spectacles.

Opinion is pretty strong that in many departments of the machinery industry there has been a falling off in trade during the past month. Of course there will always be found some who cannot be included in this statement. These are mostly confined to the large houses, who seem to be always consulted when any business in their lines is going the rounds. But the smaller concerns, who are in the majority in the trade, and who have to hustle for *all* the business they get, say that orders have been less plentiful during the past month than they have been at any time this year.

In our last issue we alluded to this fact and made some comments which reflected trade opinions concerning it. We bring the matter up again, because there are some who interpret it as an indication that business is liable to recede a little during the next few months.

It can be put down for a certainty, however, that machinery men who express themselves in this fashion are greatly in the minority. Among the generality of manufacturers the feeling is that a busy summer in the machinery industry will prevail. There are two classes who cling tenaciously to this view, and they are the manufacturers of machine tools and of electrical equipment.

Among the former considerable is heard of projects under way which will call for orders for machine tools on a large scale, and which are certain to reach the trade during the summer. In this connection mention is made of the equipments for many large machine shops which are nearing completion. It is also pointed out that railroads will figure largely in the market for tools in the next few months. From a conservative source we are informed that the trade has not wakened to a proper realization of the business that will undoubtedly emanate from this direction. Just when it will materialize cannot be learned. "But when it does," remarked

our informant, "and whether it is during the summer or some time this year, you will be surprised at its dimensions." Then it is asserted that never in the history of the trade has the substitution of new and improved tools for old and coarse ones been conducted on a more extensive scale than recently, and that never were the prospects of still greater activity in this department more bright than now.

Electrical machinery manufacturers look for a busy summer season, because of the advance information they have received concerning the extension of street railway systems and the establishment of lighting plants. Orders from the former source bid fair to be plentiful, for there is scarcely a section of the country that does not furnish news of trolley lines about to be extended. Capitalists seem to take kindly to such schemes, and are always willing to invest wherever there is a likelihood of a fair return, contending that the country is so rapidly increasing in population, especially from immigration, that the street transit industry has great possibilities. Considerable talk is also heard about new lighting plants, but the probabilities are that the majority of the orders will not be forthcoming until early in the fall. Shop installations of motor driven tools are also expected to offer some excellent business.

In boilers, engines, and machinists' supplies, the summer outlook is looked upon favorably, although in the first two mentioned industries there hasn't been the same snap to trade recently that was noticeable a short time ago. Labor troubles are put down as having had a great deal to do with this state of affairs, although in some well informed quarters there is a belief that the relation which these occupy to present and prospective trade is exaggerated.

But whether trade during the summer months will be lively or dull, manufacturers of machinery can felicitate themselves on the fact that they have enough orders on their books now to keep their plants fully occupied for that period. What is more, there is not a single branch of the machinery business to which this statement cannot be applied. As long, therefore, as machinery men can look forward to the future under such circumstances, speculation as to the developments it will bring forth need not be attended with any great apprehension.

Manufacturers of electrical machinery will be glad to learn that Mayor Low has approved the bill passed at the recent session of the legislature, empowering the New York Central Railroad to change its motive power from steam to electricity on its lines from the Grand Central Depot, New York city, to Croton, N. Y., a distance of about fifty-two miles. The bill now goes to the Governor, whose approval of it can be counted upon beyond a scintilla of doubt. It is estimated that the work would cost about $25,000,000, of which over $6,000,000 will be expended for equipment. It is said that the necessary specifications have been completed, so that they will practically be ready for the trade, when the Governor has been heard from. The trade is anxiously awaiting the specifications, and some spirited competition can be expected when they are issued.

The John Bertram & Sons Co., Dundas, Ont., manufacturers of machine tools, has substantially increased the salary of all its employees, the increase averaging fully ten per cent. It is stated that Dundas now enjoys the distinction of being the highest paid town in Canada. As one illustration of the results attending the efforts of Canadian manufacturers to meet the increasing demand for skilled labor in Canada, we quote as follows from a letter of April 25, from the John Bertram & Sons Co.: "There is a marked influx of European mechanics, particularly from Great Britain. We started here a few days ago eight Scotchmen and yesterday four Englishmen, and expect to start twice that number during the next month. We are also getting men from Buffalo and other American cities. What we are working for at present is to procure from fifty to one hundred more men, which will bring our pay list well over the 400 mark. And yet we are not more than started in the race."

Dealers in second hand material in New York State, especially in the major and minor metals, are affected by three laws signed by Governor Odell last week. One of them requires that they be licensed after July 1, 1903; another makes it a misdemeanor to purchase "junk" of any kind from a child under sixteen years of age, and the third makes it a criminal offense to buy property stolen from a railroad, gas, telephone, or telegraph company.

The Crocker-Wheeler Company report that orders recently received by them have been marked by an absence of large propositions, but their smaller orders have been as large in point of volume as at any time during the past few months.

The Lunkenheimer Company, Cincinnati, report that on account of the unprecedented demand for their well known line of brass and iron steam specialties they have been compelled to increase their foundry output 50 per cent. Machine tools of the most improved type are being installed in various departments as fast as they can be obtained.

Samuel T. Williams, mechanical engineer, is now located at the Fireman's Building, Baltimore, Md. His business has grown so great, that three machine shops are now doing his work for him. He is now building two large jib cranes for a rolling mill, preparing plans for a 250 horse-power plant, and has several large contracts in process of negotiation.

Wells Bros. & Co., Greenfield, Mass., say they are busy and that the outlook is for continued good business. They have just opened a new store at 56 Reade street, New York city, where it is their intention to carry a large stock of goods. Mr. Andrew J. Boyd will be the manager.

CHICAGO MACHINERY MARKET.

The Illinois Steel Company has purchased boilers to the extent of 20,000 horse-power for the contemplated improvements at the plants at South Chicago and Joliet. The Sterling Company secured the order. Two other orders secured by the same boiler maker were one for 16,000 horse-power at St. Louis and one for 12,000 horse-power at Detroit, both for the development of electrical power.

The above transactions are a fair illustration of the present Western market for power. There is much large work in sight and much has been closed during the past month. The Allis-Chalmers Company now has on its order books about 500,000 horse power, the largest amount in its history. Orders secured in April exceeded those of any preceding month, surpassing March this year, which to the end of that date was the record breaking period. In the April business was included many large blowing engines, including two pairs 44 and 84, 84 and 84x60, for the National Tube Company, McKeesport, Pa.; two 50 and 96, 96 and 96x60, for the National Steel Company, Pittsburgh, Pa.; two for the Shoenberger Works of the American Steel and Wire Company, Pittsburgh; two for the Carnegie Steel Company, Pittsburgh; four for the Jones & Laughlins Steel Company, Pittsburgh, Pa.; two for the Wheeling Steel and Iron Company, Wheeling, W. Va. Among the recent buyers of Corliss engines from this company were: James M. Arnold, Chicago, one 16x36; Grand Rapids Veneer Works, Grand Rapids, Mich., one 32x48; Construction Company of America, New York, two 20 and 40x42; Charles Pope, Chicago, one 12x36 and one 18x36; W. A. Jones Foundry and Machine Company, Chicago, 14x36; National Biscuit Company, New York, one 20x42; Diamond Match Company, Chico, Cal., one 32x48; Highland Park Manufacturing Company, Charlotte, N. C., one 34 and 64x60; Valley Oil Mills, Memphis, Tenn., one 18x36; Harbison-Walker Company, Pittsburgh, one 22x48. The Augsburg-Nurnberg gas engines, which the Allis-Chalmers Company will manufacture, will be built at the West Allis plant, near Milwaukee.

For small units of power there has been during April a slight lull as compared with the first three months of the year. But the view that is taken of the situation by most makers is that this lull is only temporary and that May business will show a decided betterment, or at least some improvement in the volume of business. Although in some lines of manufacture productive capacities have now increased sufficiently to provide for current wants, there are other branches where an indefinitely large expansion opens up.

Among these may be mentioned the cement industry, the demand for which continues sharply ahead of production. A large amount of power is going into that industry.

Quotations

NEW YORK, Monday, May 11.

New York prices for Northern and Southern irons for nearby delivery are as follows:

Northern:	
No. 1 X	$21 50 @ $21 75
No. 2 X	20 25 @ 20 75
No. 2 plain	19 75 @ 20 25
Southern:	
No. 1 Foundry	21 50 @ 21 75
No. 2 Foundry	20 50 @ 20 75
No. 3 Foundry	10 50 @ 19 75
No. 4 Foundry	19 00 @ 19 25

Bar Iron—Base sizes—Refined brands, mill price on dock, 1.95c. upward in carload lots. Smaller quantities from store, 2.15 @ 2.30c.

Tool Steel—Base sizes—Good standard quality, 7c.; extra grades, 10c. and upward.

Machinery Steel—Base sizes—From store, 2.10 @ 2.25c.

Cold Rolled Steel Shafting—2.90c. from store for base sizes.

Copper—Lake Superior ingot, 14¾ @ 15c.; electrolytic, 14¾ @ 15c.; casting, 14½ @ 14¾c.

Pig Tin—In 5 and 10-ton lots, f. o. b. New York, 30.10 @ 30.30c.

Pig Lead—4.37½c. for carload lots.

Spelter—5.60 @ 5.75c.

Antimony—Cookson's, 7⅝ @ 7⅞c.; Hallett's, 6¾ @ 7c.; other brands, 6½ @ 6¾c.

Lard Oil—Prime City, 81 @ 84c., according to brand and quantity, ranging from one barrel up to large lots.

Manufacturers.

The Bartels Brewing Company, Syracuse, N. Y., will build an annex.

It is proposed to enlarge the Sayre shops of the Lehigh Valley Railroad.

The American Cement Company will erect a large cement plant at Berkeley, Va.

A plant of the Consolidated Paper & Bag Company at Elkhart, Ind., has been burned.

Peter J. Chamberg, of Port Chester, N. Y., will build an ice plant at Oyster Bay, L. I.

A new and larger furnace will be built by the Wheeling (W. Va.) Iron & Steel Company.

Dewitt C. Hadcock, of Oneida, N. Y., is promoting a water power development scheme.

The Pittsburg Valve & Fittings Company is building an addition to its plant at Barberton, O.

The Brockton (Mass.) Gaslight Company has acquired land for the ultimate extension of its plant.

Plans have been made for two new structures for the Excelsior Needle Company, Torrington, Conn.

An eight-story building, 100x92 feet, is about to be built by the "John Mohr Company," Chicago, Ill.

Alterations and additions will be made to the plant of Ford Brothers & Co., coppersmiths, Philadelphia, Pa.

The Faribault (Minn.) Canning Company contemplates enlarging its plant by 30,000 cans of corn a day capacity.

Thos. F. McBride, of Clinton, N. Y., has purchased property on the Oriskany Creek, with a view to a power plant.

The general contract has been let for a new factory for the Central Brass Manufacturing Company, Cleveland, O.

The Eclipse Machine Company, of Wilmington, Del., has been incorporated to manufacture machines; capital, $100,000.

The American Locomotive Company proposes to build at Dunkirk, N. Y., a steel foundry to employ about 600 hands.

A four-story building, 60x100 feet, will be added by the New York Insulated Wire Company to its plant at Wallingford, Conn.

The workshops of the Russian Locomotive & Gun Works, Kharkoff, Russia, have been burned. The loss is estimated at $500,000.

John Briggs & Co., paint manufacturers, Boston, Mass., have let a contract for a manufacturing building, 94x64 feet, four stories.

The Klots Throwing Company, contemplates tripling its silk plant at Fredericksburg, Va., if the necessary number of operatives can be had.

The Howell & King Company, Pittston, Pa., brewer, is making preparations to enlarge its plant. A new boiler-house is included in the plans.

The McAuley Heating Apparatus Company, of Pittsburgh, Pa., has been incorporated to make and sell heating apparatus; capital, $25,000.

The Coffeyville (Kan.) Vitrified Brick & Tile Company has purchased a plant at South Denton, Tex., which it will rebuild at large expense.

A new factory building is about to be built at the plant of the Hollands Manufacturing Company, gas burners, vises and tools, Erie, Pa.

The Lyon Metallic Manufacturing Company, Chicago, remove, the latter part of this month, to their new building, 18 South Ann street, that city.

The Stowell Manufacturing & Foundry Company, South Milwaukee, Wis., has completed additions to the malleable iron plant and machine shop.

The Improved Faucet Manufacturing Company, of Altoona, Pa., has been incorporated in Delaware to manufacture patent faucets; capital, $125,000.

The contract has been let for the erection of a one and two-story pipe bending and machine shop, about 60x140 feet, for W. K. Mitchell & Co., Philadelphia.

Contracts have been awarded for the erection of a new factory of the Cincinnati Milling Machine Company, Cincinnati, O., to be built on Spring Grove avenue.

A silk mill is about to be built at Binghamton, N. Y., by a new concern to be called, we understand, the Chenango Silk Mill. John Hartley, of Scranton, Pa., is manager.

An addition, 32x85 feet, three stories, for cold storage and pressing purposes, will be built at the Atlas Refinery of oils, etc., Newark, N. J. Machinery will be installed.

A contract has been let for a 40x70 foot, three-story addition to the plant of the S. L. & G. H. Rogers Company, manufacturer of silver plated ware, at Wallingford, Conn.

The Studebaker Brothers Manufacturing Company, wagon and carriage builder, South Bend, Ind., is making financial arrangements providing for an extension of its business.

The Keenan & Hyland Manufacturing Company, bar and office fixtures, Chicago, Ill., will erect four buildings, including a planing mill and a dry kiln, all four stories high, at a cost of about $160,000.

The Devils Lake Improvement Company, of Devils Lake, N. D., is figuring on a 250 horse-power boiler, a 200 horse-power high-speed engine and a 125-kilowatt generator (direct). f. o. b. Devils Lake.

Miscellaneous Wants.

Advertisements will be inserted under this head at 25 cents a line, each insertion. Copy should be sent to reach us not later than Saturday morning for the ensuing week's issue. Answers addressed to our care will be forwarded.

Grant. Gears. See upper corner, page 62.

Caliper cat. free. E. G. Smith, Columbia, Pa.

Punches & dies. Wal.M.Wks., Waltham, Mass.

Patterns.—Cincinnati Pat. Wks., Cincin., O.

Experimental work. Geo. M. Mayer, M. E., Monadnock, Chicago.

Drawings, patterns and models to order. Ashland Tool Co., Ashland, Pa.

Will buy or pay royalty for good patented machine or tool. Box 282, AMER. MACH.

Light and fine mach'y to order; models and elec. work specialty. E. O. Chase, Newark, N. J.

Automatic machinery designed and constructed by the Wellman Sole Cutting Machine Co., Medford, Mass.

Wanted—Air compressor, new or second hand, steam driven, 400 cu. ft. capacity. Box 276, AMERICAN MACHINIST.

Wanted—Competent managers, superintendents and foremen. James Brady, Room J, 20th Floor, 220 Broadway, New York.

Special and light machinery, models; subpress and blanking dies a specialty, also fine tool work. Box 250, Waterbury, Conn.

Designing auto. mach'y tools for interchangeable work a specialty; drawings made at moderate prices. Box 943, New Haven, Ct.

Machinists—Send 10 cents for blueprint table of U. S. S. steam, gas and water pipe, giving tapping sizes. E. E. Meyer, Allegheny, Pa.

Wanted—Contract and jobbing work on medium and heavy weight machinery and parts; prompt delivery. U. S. Rapid-Fire Gun & Power Co., Derby, Conn.

A No. 1 salesman or manager, living in or around New York, who wishes to give up the road can do better at home. For particulars: P. O. Box 12, Madison Square, New York.

Draftsmen desiring occasional extra business in line with drafting; state where regularly employed; confidential. Address Edwin Guthrie, Corcoran Building, Washington, D. C.

I desire to know of an establishment that can make special tools and manufacture on contract a pencil-sharpening machine; interchangeable work required. A. V., care A. M.

Wanted—Short contributions by practical power plant engineers for a publication for steam engineers; illustrated when possible. Technical Publishing Co., Burns Bldg., Detroit, Mich.

"Screw Cutting Simplified, Direct and Compound"; compiled and for sale by C. B. Sands, 118 Eleanor st., Philadelphia, Pa.; I guarantee thorough knowledge of screw cutting to all purchasers; price 50 cents.

Wanted—To correspond with a practical oil-country mechanic and business man, with some capital, who might desire to acquire a working interest in a growing and successful manufacturing and jobbing foundry and machine shop business. Address "Ohio River," care AMERICAN MACHINIST.

For Sale.

For Sale—An established and successful machinery manufacturing business in a town of 10,000 inhabitants; modern brick buildings, fine water power, good shipping facilities, etc.; satisfactory reasons for selling; a grand opportunity to the right party who can invest not less than $100,000 after the fullest investigation. Address "Machinery Manufacturer," care AMERICAN MACHINIST.

Wants.

Situation and Help Advertisements only inserted under this head. Rate 25 cents a line for each insertion. About six words make a line. No advertisements under two lines accepted, and no advertisements abbreviated. The cash and copy should be sent to reach us not later than Saturday morning for

the ensuing week's issue. Answers addressed to our care will be forwarded. Applicants may specify names to which their replies are not to be forwarded; but replies will not be returned. If not forwarded they will be destroyed without notice. Original letters of recommendation or other papers of value should not be enclosed to unknown correspondents. State mentioned indicates present address of advertiser.

Situations Wanted.

CONNECTICUT.

Position as foreman, small die and tool department, by experienced mechanic; expert at organizing and systematizing. Address Box 13, Norwich, Conn.

Wanted—Position as superintendent, by head draftsman, now with a well-known firm, builders of metal-working machinery. Address Box 263, AMERICAN MACHINIST.

Position wanted as superintendent, chief draftsman or designer, by mechanical engineer, 18 years' practical experience, manufacturing a specialty. Box 271, AMER. MACH.

Mechanical engineer possessing ability, besides a high-grade technical education and an extensive experience, wishes to communicate with large manufacturing concerns with a view of obtaining a leading position. Box 272, AMERICAN MACHINIST.

ILLINOIS.

Mechanical engineers want positions; we have investigated their records and references; we can furnish competent men for all kinds of technical work. Engineering Agency, 19 Monadnock Block, Chicago.

MASSACHUSETTS.

Thoroughly competent foreman wishes position making foundry molding machines. Box 285, AMERICAN MACHINIST.

Wanted—Situation as boss polisher; 18 years' experience; best reference. W. E. S., care AMERICAN MACHINIST.

Mechanical draftsman and practical mechanist, with wide experience, desires responsible position about June 1. Box 260, A. M.

Young draftsman, with experience on machine tools, wishes position to improve in designing high-grade machine tools; has had shop experience. Box 247, AMER MACH.

Patternmaker, 16 years' experience on heavy and light tools, thoroughly understands coring, capable of taking charge, would like to correspond with parties wanting A1 man. Box 248, AMERICAN MACHINIST.

MICHIGAN.

Position as superintendent or general foreman, by thoroughly practical machinist; large experience with men and work; good organizer, manager and executive; highest reference; would consider taking stock in first-class company as part salary. Box 279, AMERICAN MACHINIST.

NEW HAMPSHIRE.

Blacksmith, first-class tool dresser, desires change within New England. Box 245, A. M.

NEW JERSEY.

Position as superintendent or assistant superintendent, by man of proven executive and mechanical ability; 15 years' shop experience, good organizer and cost accountant; now hold position of general foreman, running 90 men; to work in larger capacity is only desire for change. Box 288, AM. MACH.

NEW YORK.

Machine designer, etc., wants position. Address Box 63, AMERICAN MACHINIST.

Draftsman, on detail work, desires change; 2 years' drawing-room, 5 years' shop experience. Box 266, AMERICAN MACHINIST.

Draftsman, familiar with machinery, mill and furnace work, wishes position in the vicinity of New York. Box 280, AM. MACH.

Wanted—Position as foreman patternmaker by experienced mechanic, competent to handle both men and work to advantage. Box 277, AMERICAN MACHINIST.

Position as foreman; 15 years' machine-shop and drawing-room experience; A1 mechanic; first-class references. Address Box 281, AMERICAN MACHINIST.

A reliable mechanical superintendent, now employed, would change; experienced in modern methods, duplicate or interchangeable work, also brass goods; could add a good paying line; references from past and present employers. Address P. O. Box 1533, New York.

Young, active engineer, European graduate in mechanical and electrical engineering and chemistry, experienced in detail work and developing inventions, competent designer, thoroughly familiar with modern shop practice and manufacturing, capable of turning out good work, neatly and cheaply, desires steady engagement with progressive concern in New York city. Address Box 270, AMER. MACH.

PENNSYLVANIA.

Mechanical and electrical draftsman with shop and office practice, at present holding responsible position, is open for engagement as chief draftsman or designer; South or Southwest. Box 273, AMERICAN MACHINIST.

Superintendent of power plant desires to make a change; am posted on machine shop electrical equipment in either alternating or direct current, laying out construction and operation. Address Box 287, AMER. MACH.

A high-grade engine machinist, served regular apprenticeship, years of experience, disengaged July 1, is open to engagement; nothing but high-grade automatic engine shop considered; Pennsylvania or Illinois preferred. Address "Engine Machinist," care AM. MACH.

WISCONSIN.

Position as shop superintendent, by practical man, in shop doing general job work in mining and sawmill machinery, engine and air-compressor work; I am at present located in Wisconsin. Reply Box 267, AMER. MACH.

Help Wanted.

ILLINOIS.

Draftsmen for all classes of work; over 200 actual vacancies for technical men in all parts of U. S.; 5,000 positions filled in 10 years. Engineering Agency, 19 Monadnock Block, Chicago.

We are constantly increasing the scope of our work and invite applications for positions from first-class patternmakers, molders and machinists; we always have vacancies. Address Allis-Chalmers Co., Lock Box No. 1065, Chicago.

MARYLAND.

Machinists Wanted: Experienced milling machine hands, lathe hands and general hands on jig and fixture work; 54-hour, open shop; no strike; small and medium size work; mention place of present or previous employment and state fully regarding experience and ability. Ott. Mergenthaler Company, Baltimore, Md.

MASSACHUSETTS.

Wanted—Machinist for lathe work, also young man for office, also toolmaker on cutter work. Boston Gear Works, Boston, Mass.

Machinists wanted; good, all-round men on special automatic machinery; good pay and steady work. Apply to L. F. Fales, Walpole, Mass.

Machine blacksmith wanted in a job shop near Boston; one who can run a lathe; good pay to a good, handy man; also wanted, milling machine hands. Box 205, AMER. MACH.

Draftsmen wanted; experienced men only, on special tool design for light, interchangeable work of very highest character. Address, stating full experience, references and salary expected. Box 274, AMERICAN MACHINIST.

MICHIGAN.

Wanted—A first-class man to take a responsible position in a modern machine manufacturing plant, in a desirable city of one of the Middle States; must have had experience in manufacturing sewing machines, gun work or some light, high-grade machine manufacturing; must be familiar with the most advantageous ways and means of manufacturing by the use of modern, up-to-date machinery, fixtures and methods; a man of ability and character, who has had experience and is a good manager of men, who is systematic, broad gage and knows how to get results, can secure a good, permanent position; state age, experience, references and salary wanted. Write full particulars to Box 268, AMER. MACHINIST.

NEW JERSEY.

Wanted—Experienced watch factory machine shop foreman; state age, experience, etc. Address "Foreman," care AMER. MACH.

Wanted—Lathe and planer hands for night work on heavy machine tool work; good wages to good men. Apply to The Pond Machine Tool Company, Plainfield, N. J.

Foreman of machine shop wanted to take charge of operating one department of a rock crushing plant in New Jersey; must have had considerable experience in general machine work and full charge of at least twenty-five (25) men; give names of shops in which you have worked and length of time in each place, also full personal references; replies without full details will not be noticed; wages six dollars ($6) per day. Address "Cement," Orange, N. J.

NEW YORK.

Wanted—Two good wood pattern makers; state age and experience. The Goulds Mfg. Co., Seneca Falls, N. Y.

Wanted—All-round draftsmen; in writing, state age, references and salary expected. Eastman Kodak Company, Rochester, N. Y.

Wanted—Two first-class mechanical draftsmen, with 2 or 3 years' experience; give full particulars and salary expected. Address Box 242, AMERICAN MACHINIST.

Wanted—First-class lathe hands, all-round machinists and toolmakers; steady work; good pay. H. H. Franklin Mfg. Co., Automobile Dept., Syracuse, N. Y.

Foreman diemaker with wide experience, progressive and who can produce dies for sheet metal work at competitive prices. Address, with particulars, Box 269, AM. MACH.

Wanted—By independent company in Greater New York, a good executive foreman to take charge of machining and assembling parts for steam pumps. Box 275, AMER. MACHINIST.

Wanted—A foreman foundryman to give instruction in a technical school (New York) for a period of three weeks in June; should be a man between 25 and 50 years of age, with broad experience. Address "Teacher," care AMERICAN MACHINIST.

Wanted—A mechanical and manufacturing superintendent with technical experience, for a large firm in central New York employing 400 to 500 men; state age and experience; only bright and aggressive men need apply. Box 265, AMERICAN MACHINIST.

Machinists wanted in a small manufacturing town, one hour's ride from New York city; wages $2.50 per day of 9 hours; time and a half for over time; factory employs about 300 men; has been in existence over 20 years, during which time it has never reduced wages or laid off men for lack of work; special inducements will be offered desirable men at this time; state nationality, age and experience for past 5 years. Box 200, AM. M.

OHIO.

Wanted—Lathe hands, planer hands, vise hands, milling machine hands; good wages and steady work. Apply to the Harris Automatic Press Company, Niles, O.

Wanted—Two good draftsmen, familiar with machine tool detail work; men who have experience in construction preferred. Address Cincinnati Milling Machine Co., Cincinnati, O.

Wanted—Lathe designer, one who has had a number of years' experience in the design of good, up-to-date lathes, and one who has good practical ideas; this position holds out an unlimited future for a good man; give experience, age, etc. Address "Cincinnati," care AMERICAN MACHINIST.

Wanted—An all-round machinist to act as superintendent in a shop, in Cincinnati, doing light manufacturing and special work and employing between 20 and 30 men; applicant must be capable of overseeing machine and vise work and must have had experience as foreman of both; a good opening for an energetic and up-to-date young man. Apply, giving age, whether married and references (which will be treated as strictly confidential), Box 278, AMERICAN MACHINIST.

PENNSYLVANIA.

Experienced mechanical draftsman wanted; permanent employment assured to rapid and accurate draftsman. "Mill Work," care A. M.

Machinists—First-class lathe men and engine builder; steady work; permanent situations to right men. Call or address Keystone Driller Co., Beaver Falls, Pa.

Wanted—First-class fitters, experienced on vertical boring and turning mills; good wages and steady employment. Colburn Machine Tool Company, Franklin, Pa.

Wanted—A foreman for erecting and testing floor in shop building high and medium speed engines; give details of experience, age, nationality and pay expected. Box 226, A. M.

We are constantly increasing the scope of our work, and invite application for positions from first-class patternmakers, molders and machinists; we always have vacancies. Address The Westinghouse Machine Company, East Pittsburgh, Pa.

First-class, experienced mechanical draftsmen wanted at once; some of them acquainted with electrical work; those with shop experience preferred. Apply, by letter, to Chief Draftsman, P. O. Box 911, Pittsburg, Pa., stating experience in full and giving references.

Wanted—A reliable superintendent for a factory manufacturing a light iron and sheet metal specialty; applicant must be ambitious and have had experience in handling and developing men; a technical sheet iron worker preferred; give reference, experience and salary expected. Box 284, AMER. MACHINIST.

RHODE ISLAND.

First-class tool or model makers on light, high-grade machinery. Taft-Peirce Works, Woonsocket, R. I.

WISCONSIN.

Wanted—Competent machine and bench hands. The Kempsmith Mfg. Co., Milwaukee, Wis.

An experienced crane salesman to represent us on the road; to a man suited to our needs an excellent opportunity is offered; ap-

plications treated confidentially. Pawling & Harnischfeger, Milwaukee, Wis.

SOUTH AFRICA.

South Africa.—Wanted—A young man to go to South Africa in employ of well-established Johannesburg company representing American manufacturers: age about 24-25: good technical education, quick at figures, willing to learn, conversant with American business methods and engineering practices and preferably having had experience in drawing up specifications for and figuring upon induced draft plants, boilers, compressors, engines, structural iron work, machine tools, pumps and general mine supplies: answer in full detail, giving exact experience and references. Box 283, AMERICAN MACHINIST.

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Northampton Emery Wheel Co., Leeds, Mass.
Norton Emery Wheel Co., Worcester, Mass.

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Barnes Co., W. F. & John, Rockford, Ill
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Ball Bearings

See Roller Bearings.

Balls, Steel

Federal Mfg. Co., Cleveland, O.

Bars, Boring

Cleveland Twist Drill Co., Cleveland, O.
Underwood & Co., H. B., Philadelphia, Pa.

Barrels, Steel

Kilbourne & Jacobs Mfg. Co., Columbus, O.

Belt Dressing

Dixon Crucible Co., Jos., Jersey City, N. J.
Harris Oil Co., A. W., Provl., R. I.

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Patterson, Gottfried & Hunter, Ltd., New York.
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Bement, Miles & Co., New York.
Watson-Stillman Co., New York.

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Bethlehem Foundry & Mach. Co., So. Bethlehem, Pa.
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Reade Mchry Co., Cleveland, O.

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See Hoists, Hand.

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Am. Gas Furnace Co., N. Y. City.
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Champion Blower & Forge Co., Lancaster, Pa.
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Maines Mach. Co., Philadel., Pa.
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Reliance Mach. & Tool Co., Cleveland, O.
Webster & Perks Tool Co., Springfield, O.
Wells Bros. Co., Greenfield, Mass.

Books, Mechanical
Baird & Co., Henry Carey, Philadelphia, Pa.
Derry-Collard Co., New York.
Henley & Co., N. W., New York.
Wiley & Sons, John, New York.

Boring and Drilling Machines, Horizontal
Barnes Co., B. F., Rockford, Ill.
Barnes Co., W. F. & John, Rockford, Ill.
Beaman & Smith Co., Provi., R. I.
Bement, Miles & Co., N. Y. City.
Betts Mach. Co., Wilmington, Del.
Binsse Mach. Co., Newark, N. J.
Dallett & Co., Thos. H., Phila., Pa.
Detrick & Harvey Mach. Co., Baltimore, Md.
Draper Mach. Tool Co., Worcester, Mass.
Fosdick Mach. Tool Co., Cincinnati, O.
McCabe, J. J., New York.
Newton Mach. Tool Wks., Philadelphia, Pa.
Niles Tool Works Co., New York.
Pond Mach. Tool Co., New York.
Pratt & Whitney Co., Hartford, Conn.
Prentiss Tool & Supply Co., New York.
Warner & Swasey Co., Cleveland, Ohio.

Boring and Turning Mills
American Tool Wks. Co., Cin., O.
Baush Mach. Tool Co., Springfield, Mass.
Bement, Miles & Co., New York.
Betts Mach. Co., Wilmington, Del.
Brown & Zortman Mchy. Co., Pittsburg, Pa.
Bullard Mach. Tool Co., Bridgeport, Conn.
Fairbanks Co., New York.
Hill, Clarke & Co., Boston, Mass.
McCabe, J. J., New York.
Niles Tool Works Co., New York.
Pond Mach. Tool Co., New York.
Prentiss Tool & Supply Co., New York.
Warner & Swasey Co., Cleveland, Ohio.

Carborundum
See Grinding Wheels.

Castings, Die Molded
Franklin Mfg. Co., Syracuse, N. Y.

Castings, Steel
Christensen Engineering Co., Milwaukee, Wis.
sonia, Conn.
Uniform Steel Co., Rahway, N. J.

Centering Machines
Bement, Miles & Co., New York.
Niles Tool Works Co., New York.
Phoenix Mfg. Co., Hartford, Conn.
Pond Mach. Tool Co., New York.
Whiton Machine Co., D. E., New London, Conn.
Woodward & Rogers Co., Hartford, Conn.

Centers, Planer
Fay & Scott, Dexter, Me.
New Haven Mfg. Co., New Haven, Conn.
Pratt & Whitney Co., Hartford, Conn.
Reed Co., F. E., Worcester, Mass.

Chains, Driving
Boston Gear Works, Boston, Mass.
Bridgeport Chain Co., Bridgeport, Conn.
Federal Mfg. Co., Cleveland, O.
Jeffrey Mfg. Co., The, Columbus, Ohio.
Link Belt Engr. Co., Phila., Pa.
Morse Chain Co., Trumansburg, N. Y.
Whitney Mfg. Co., Hartford, Ct.

Chucking Machines
Brown & Sharpe Mfg. Co., Providence, R. I.
Cleveland Automatic Mach. Co., Cleveland, O.
Draper Mach. Tool Co., Worcester, Mass.
Le Blond Mach. Tool Co., R. K., Cincinnati, O.
Potter & Johnston Mach. Co., Pawtucket, R. I.
Pratt & Whitney Co., Hartford, Conn.
Quint, A. D., Hartford, Conn.
Reed Co., F. E., Worcester, Mass.
Warner & Swasey Co., Cleveland, Ohio.
Windsor Mach. Co., Windsor, Vt.

Chucks, Drill
Almond, T. R., Brooklyn, N. Y.
Brown & Co., R. H., New Haven, Conn.
Cleveland Twist Drill Co., Cleveland, O.
Cushman Chuck Co., Hartford, Ct.
Goodell-Pratt Co., Greenfield, Mass.
The E. Horton & Sons Co., Windsor Locks, Conn.
Modern Tool Co., Erie, Pa.
Morse Twist Drill & Mch. Co., New Bedford, Mass.
Pratt Chuck Co., Frankfort, N. Y.
Standard Tool Co., Cleveland, O.
Trump Bros. Mach. Co., Wilmington, Del.
Whitney Mfg. Co., Hartford, Ct.
Whiton Mach. Co., D. E., New London, Conn.

Chucks, Lathe
Cushman Chuck Co., Hartford, Ct.
Hoggson & Pettis Mfg. Co., New Haven, Conn.
The E. Horton & Son Co., Windsor Locks, Conn.
Pratt & Whitney Co., Hartford, Conn.
Skinner Chuck Co., New Britain, Conn.
Westcott Chuck Co., Oneida, N. Y.
Whiton Mach. Co., D. E., New London, Conn.

Chucks, Scroll
Whiton Mach. Co., D. E., New London, Conn.

Chucks, Split
Faneuil Watch Tool Co., Boston, Mass.

Clocks, Watchman's
Nanz & Co., H., New York.

Clutches, Friction
Caldwell, Son & Co., H. W., Chicago, Ill.
Faneuil Watch Tool Co., Boston, Mass.
Jacobson Mach. Mfg. Co., Warren, Pa.
New Haven Mfg. Co., New Haven, Conn.
Patterson, Gottfried & Hunter, Ltd., New York.
Pratt & Whitney Co., Hartford, Conn.
Smith, F. L., Franklin Falls, N. H.

Compound, Boiler
Harris Oil Co., A. W., Provi., R. I.

Compound, Pipe Joint
Dixon Crucible Co., Jos., Jersey City, N. J.

Compressors, Air
Blanchard Mach. Co., Boston, Mass.
Chicago Pneumatic Tool Co., Chicago, Ill.
Christensen, N. A., Milwaukee, Wis.
Curtis & Co. Mfg. Co., St. Louis, Mo.
Gray-Blaisdell Co., Bradford, Pa.
Herron & Bury Mfg. Co., Erie, Pa.
Ingersoll-Sergeant Drill Co., New York.
Jacobson Mach. Mfg. Co., Warren, Pa.
Rand Drill Co., New York.

Consulting Engineer
Thompson, Hugh L., Waterbury, Conn.

Controllers and Starters, Electric Motor
Cutler-Hammer Mfg. Co., Milwaukee, Wis.

Coping Machines
Long & Allstatter Co., Hamilton, Ohio.

Correspondence Schools
See Schools, Correspondence.

Counterbores
Slocomb Co., J. T., Provi., R. I.

Countershafts
Builders' Iron Fdry., Provi., R. I.
National Machine Tool Co., Cincinnati, O.
Pratt & Whitney Co., Hartford, Conn.
Reeves Pulley Co., Columbus, Ind.
Wilmarth & Morman Co., Grand Rapids, Mich.

Counters, Machinery
Veeder Mfg. Co., Hartford, Conn.

Counting and Printing Wheels
Franklin Mfg. Co., Syracuse, N. Y.

Couplings, Shaft
Caldwell & Son Co., H. W., Chicago, Ill.
Cresson Co., Geo. V., Philadel., Pa.
Davis Mach. Co., W. P., Rochester, N. Y.
Patterson, Gottfried & Hunter, Ltd., New York.
Stuart, R. J., New Hamburg, N. Y.

Cranes
Brown Hoisting Mach. Co., N. Y. City.
Case Mfg. Co., Columbus, O.
Chambersburg Engr. Co., Chambersburg, Pa.
Cleveland Crane & Car Co., Cleveland, O.
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Northern Engineering Works, Detroit, Mich.
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Pawling & Harnischfeger, Milwaukee, Wis.
Sellers & Co., Wm., Philadel., Pa.
Whiting Foundry Equipment Co., Harvey, Ill.

Crank Pin Turning Machine
Underwood & Co., H. B., Philadelphia, Pa.

Crucibles
Dixon Crucible Co., Jos., Jersey City, N. J.
Obermayer Co., S., Cincinnati, O.

Cupolas, and Ladles, Foundry
Northern Engr. Works, Detroit, Mich.
Obermayer Co., S., Cincinnati, O.
Paxson Co., J. W., Philadel., Pa.
Whiting Foundry Equip. Co., Harvey, Ill.

Cutters, Milling
Becker-Brainard Milling Mach. Co., Hyde Park, Mass.
Brown & Sharpe Mfg. Co., Providence, R. I.
Cleveland Twist Drill Co., Cleveland, O.
Gay & Ward, Athol, Mass.
Ingersoll Milling Mach. Co., Rockford, Ill.
Morse Twist Drill & Mach. Co., New Bedford, Mass.
Rogers, John M., Boat, Gage & Drill Works, Gloucester City, N. J.
Standard Tool Co., Cleveland, O.
Whitney Mfg. Co., Hartford, Conn.

Cutting-off Machines
Bement, Miles & Co., New York.
Bignall-Keeler Mfg. Co., Edwardsville, Ill.
Brown & Sharpe Mfg. Co., Providence, R. I.
Davis Mach. Co., W. P., Rochester, N. Y.
Halibut-Rogers Mach. Co., South Sudbury, Mass.
Newton Mach. Tool Wks., Philadelphia, Pa.
Niles Tool Works Co., New York.
Pond Mach. Tool Co., New York.

Cutting-off Tools
Armstrong Bros. Tool Co., Chicago, Ill.
O. K. Tool Holder Co., Shelton, Conn.
Pratt & Whitney Co., Hartford, Conn.

Cyclometers
Veeder Mfg. Co., Hartford, Conn.

Diamond Tools
Steel Set Diamond Co., New York.

Dies, Sheet Metal
Bliss Co., E. W., Brooklyn, N. Y.
Hay-Budden Mfg. Co., Brooklyn, N. Y.
Perkins Mach. Co., So. Boston, Mass.
Wold & Co., Torris, Chicago, Ill.

Dies, Threading, Opening
Errington, F. A., New York.
Geometric Drill Co., New Haven, Conn.
Jones & Lamson Mch. Co., Springfield, Vt.
Maines Mach. Co., Philadel., Pa.
Modern Tool Co., Erie, Pa.
Pratt & Whitney Co., Hartford, Conn.

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Obermayer Co., S., Cincinnati, O.
Winkley Co., Hartford, Conn.

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Keuffel & Esser Co., New York.

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Barnes Co., W F. & John, Rockford, Ill.
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Bement, Miles & Co., New York.
Bickford Drill & Tool Co., Cincinnati, O.
Dallett & Co., Thos. H., Phila., Pa.
Niles Tool Works Co., New York.
Pond Mach. Tool Co., New York.

Drilling Machines, Portable
Dallett & Co., Thos. H., Philadelphia, Pa.
Hisey-Wolf Mch. Co., Cincin., O.

Drilling Machines, Multiple Spindle

Baker Bros., Toledo, O.
Barnes Co., B. F., Rockford, Ill.
Barnes Co., W. F. & John, Rockford, Ill.
Barr, H. G., Worcester, Mass.
Baush Mch. Tool Co., Springfield, Mass.
Bement, Miles & Co., New York.
Bickford Drill & Tool Co., Cincinnati, O.
Dallett & Co., Thos. H., Phila., Pa.
Fairbanks Co., New York.
Garvin Mach. Co., New York.
Harrington, Son & Co., Edwin, Philadelphia, Pa.
McCabe, J. J., New York.
Marshall & Huschart Mchry. Co., Chicago, Ill.
National Automatic Tool Co., Dayton, O.
Newton Machine Tool Works, Philadelphia, Pa.
Niles Tool Works Co., New York.
Prentiss Tool & Supply Co., New York.
Woodward & Rogers Co., Hartford, Conn.

Drilling Machines, Pneumatic

Chicago Pneumatic Tool Co., Chicago, Ill.
Cleveland Pneu. Tool Co., Cleveland, O.
Phila. Pneumatic Tool Co., Philadelphia, Pa.
Railway Appliances Co., Chicago, Ill.
Rand Drill Co., New York.
Standard Ry. Equip. Co., St. Louis, Mo.

Drilling Machines, Radial

American Tool Wks. Co., Cin., O.
Baush Mch. Tool Co., Springfield, Mass.
Bement, Miles & Co., New York.
Bickford Drill & Tool Co., Cincinnati, O.
Cleveland Punch & Shear Works Co., Cleveland, O.
Dreses Mach. Tool Co., Cincin., O.
Fairbanks Co., New York.
Fosdick Mach. Tool Co., Cincin., O.
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Hill, Clarke & Co., Boston, Mass.
McCabe, J. J., New York.
Marshall & Huschart Mchry. Co., Chicago, Ill.
Mueller Mach. Tool Co., Cincin., O.
Niles Tool Works Co., New York.
Pond Mach. Tool Co., New York.
Prentiss Tool & Supply Co., New York.
Reade Mchry. Co., Cleveland, O.

Drilling Machines, Turret

Niles Tool Works Co., New York.
Quint, A. D., Hartford, Conn.
Vanderbeek Tool Works, Hartford, Conn.

Drilling Machines, Upright

American Tool Wks. Co., Cin., O.
Baker Bros., Toledo, O.
Barnes Co., B. F., Rockford, Ill.
Barnes Co., W. F. & John, Rockford, Ill.
Barr, H. G., Worcester, Mass.
Bement, Miles & Co., New York.
Brown & Zortman Mchry. Co., Pittsburg, Pa.
Cincinnati Mach. Tool Co., Cin., O.
Davis Mach. Co., W. P., Rochester, N. Y.
Dwight Slate Mach. Co., Hartford, Conn.
Fairbanks Co., New York.
Fosdick Mach. Tool Co., Cincinnati, O.
Gould & Eberhardt, Newark, N. J.
Harrington & Son Co., Edwin, Philadelphia, Pa.
Hill, Clarke & Co., Boston, Mass.
Hoefer Mfg. Co., Freeport Ill.
Le Blond Mach. Tool Co., R. K., Cincinnati, O.
McCabe, J. J., New York.
Marshall & Huschart Mchry. Co., Chicago, Ill.
Niles Tool Works Co., New York.
New Haven Mfg. Co., New Haven, Conn.
Pratt & Whitney Co., Hartford, Conn.
Prentiss Tool & Supply Co., New York.
Sibley & Ware, South Bend, Ind.
Washburn Shops, Worcester, Mass.
Whitney Mfg. Co., Hartford, Conn.
Woodward & Rogers Co., Hartford, Conn.

Drills, Center

Pratt & Whitney Co., Hartford, Conn.
Slocomb Co., J. T., Providence, R. I.

Drills, Rail

Bement, Miles & Co., New York.
Niles Tool Works Co., New York.

Drills, Ratchet

Parker Co., Chas., Meriden, Conn.
Pratt & Whitney Co., Hartford, Conn.

Dust Collectors

Allington & Curtis Mfg. Co., Saginaw, Mich.

Dynamos

C & C Electric Co., New York.
Christensen Engineering Co., Milwaukee, Wis.
Commercial Electric Co., Indianapolis, Ind.
Crocker-Wheeler Electric Co., Ampere, N. J.
Eck Dynamo & Motor Co., Belleville, N. J.
General Elec. Co., New York.
Jantz & Leist Elec. Co., Cincin., O.
Mechanical Appliance Co., Milwaukee, Wis.
Milwaukee Elec. Co., Milwaukee, Wis.
Northern Elec. Mfg. Co., Madison, Wis.
Robbins & Myers Co., Springfield, Ohio.
Sprague Elec. Co., New York.
Star Dynamo Works, Jefferson City, Mo.
Storey Motor & Electric Co., Harrison, N. J.
Triumph Elec. Co., Cincinnati, O.
Western Electric Co., Chicago, Ill.
Westinghouse Electric & Mfg. Co., Pittsburgh, Pa.

Electrical Supplies

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Westinghouse Electric & Mfg. Co., Pittsburgh, Pa.

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Albro-Clem Elevator Co., Philadelphia, Pa.
Curtis & Co. Mfg. Co., St. Louis, Mo.
Howard Iron Wks., Buffalo, N. Y.
Morse, Williams & Co., Phila., Pa.

Emery Wheels

See Grinding Wheels.

Emery Wheel Dressers

Calder, Geo. H., Lancaster, Pa.

Enclosures, Tool-room

Merritt & Co., Philadelphia, Pa.

Engines, Automobile

Olds Motor Works, Lansing, Mich.

Engines, Gas and Gasoline

Bay State Gas Engine Co., Boston, Mass.
Foos Gas Eng. Co., Springfield, O.
Middletown Mach. Co., Middletown, O.
Mietz, August, New York.
New Era Iron Wks., Dayton, O.
Olds Motor Wks., Lansing, Mich.
Regal Gasoline Engine Co., Coldwater, Mich.
Struthers-Wells Co., Warren, Pa.

Engines, Steam

Buffalo Engine Co., Buffalo, N. Y.
Chandler & Taylor Co., Indianapolis, Ind.
Frick Co., Waynesboro, Pa.
Rand Drill Co., New York.
Struthers-Wells Co., Warren, Pa.

Fans, Electric

General Electric Co., New York.
Northern Elec. Mfg. Co., Madison, Wis.
Sprague Elec. Co., New York.
Western Electric Co., Chicago, Ill.
Westinghouse Elec. & Mfg. Co., Pittsburgh, Pa.

Fans, Exhaust

Buffalo Forge Co., Buffalo, N. Y.

Feed Water Heater and Purifier

Hawley Down Draft Furnace Co., Chicago, Ill.

Files and Rasps

Barnett Co., G. & H., Phila., Pa.
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Nicholson File Co., Provi., R. I.
Patterson, Gottfried & Hunter, Ltd., New York.

Filing Machines

Cochrane-Bly Mach. Co., Rochester, N. Y.

Fillers, Oil Can

The Winkley Co., Hartford, Conn.

Fittings, Steam

Crane Co., Chicago, Ill.
Crosby Steam Gage & Valve Co., Boston, Mass.
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Lunkenheimer Co., Cincinnati, O.
Walworth Mfg. Co., Boston, Mass.

Flexible Shafts

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Forges

Buffalo Forge Co., Buffalo, N. Y.
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Patterson, Gottfried & Hunter, Ltd., New York.

Forgings, Drop

Billings & Spencer Co., Hartford, Conn.
Miner & Peck Mfg. Co., New Haven, Conn.
Wyman & Gordon, Worcester, Mass.

Forgings, Hydraulic

Wyman & Gordon, Worcester, Mass.

Forgings, Steel

Hay-Budden Mfg. Co., Brooklyn, N. Y.
Wyman & Gordon, Worcester, Mass.

Foundry Furnishings

Obermayer Co., S., Cincinnati, O.
Paxson Co., J. W., Philadel., Pa.
Whiting Foundry Equip. Co., Harvey, Ill.

Furnaces, Coal and Oil

Buffalo Forge Co., Buffalo, N. Y.
Hawley Down Draft Furnace Co., Chicago, Ill.
Jacobson Mach. Mfg. Co., Warren, Pa.
Obermayer Co., S., Cincinnati, O.

Furnaces, Gas

Am. Gas Furnace Co., N. Y., City.
Chicago Flexible Shaft Co., Chicago, Ill.

Furniture, Machine Shop

New Britain Mach. Co., New Britain, Conn.

Gages, Recording

Bristol Co., Waterbury, Conn.

Gages, Standard

Brown & Sharpe Mfg. Co., Providence, R. I.
Rogers, John M., Boat, Gage & Drill Works, Gloucester City, N. J.
Sawyer Tool Mfg. Co., Fitchburg, Mass.
Slocomb Co., J. T., Prov., R. I.
Starrett Co., L. S., Athol, Mass.

Gages, Steam

Crosby Steam Gage & Valve Co., Boston, Mass.

Gear Cutting Machinery

Becker-Brainard Milling Mach. Co., Hyde Park, Mass.
Bickford Drill & Tool Co., Cin., O.
Brown & Sharpe Mfg. Co., Providence, R. I.
Dwight Slate Mch. Co., Hartford, Conn.
Fellows Gear Shaper Co., Springfield, Vt.
Gleason Tool Co., Rochester, N. Y.
Gould & Eberhardt, Newark, N. J.
Harrington & Son Co., Edwin, Philadelphia, Pa.
Newton Mch. Tool Wks., Phil., Pa.
Niles Tool Works Co., New York.
Whiton Machine Co., D. E., New London, Conn.

Gears, Cut

Bilgram, Hugo, Philadelphia, Pa.
Boston Gear Works, Boston, Mass.
Brown & Sharpe Mfg. Co., Providence, R. I.
Fawcus Mach. Co., Pittsburgh, Pa.
Fellows Gear Shaper Co., Springfield, Vt.
Gleason Tool Co., Rochester, N. Y.
Gould & Eberhardt, Newark, N. J.
Grant Gear Works, Boston, Mass.
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Horsburgh & Scott Co., The, Cleveland, O.
New Process Raw Hide Co., Syracuse, N. Y.
Nuttall Co., R. D., Pittsburgh, Pa.
Patterson, Gottfried & Hunter, Ltd., New York.
Philadelphia Gear Works, Philadelphia, Pa.
Sawyer Gear Wks., Cleveland, O.
Simonds Mfg. Co., Pittsburgh, Pa.

Gears, Molded

Caldwell & Son Co., H. W., Chicago, Ill.
Franklin Mfg. Co., Syracuse, N. Y.
Greenwald Co., I. & E., Cincin., O.

Gears, Rawhide

Chicago Raw Hide Co., Chicago, Ill.
Fawcus Mch. Co., Pittsburgh, Pa.
Horsburgh & Scott Co., Cleveland, Ohio.
New Process Raw Hide Co., Syracuse, N. Y.
Nuttall Co., R. D., Pittsburgh, Pa.

Gears, Worm

Albro-Clem Elevator Co., Philadelphia, Pa.
Fawcus Mach. Co., Pittsburgh, Pa.
Morse, Williams & Co., Phila., Pa.
Nuttall Co., R. D., Pittsburgh, Pa.
Simonds Mfg. Co., Pittsburgh, Pa.

Graphite

Dixon Crucible Co., Jos., Jersey City, N. J.
Lubriphite Co., Jersey City, N. J.
Obermayer Co., S., Cincinnati, O.

Grinders, Center

Heald & Son, L. S., Barre, Mass.
Hisey-Wolf Mach. Co., Cincin., O.

Grinders, Cock

Windsor Mach. Co., Windsor, Vt.

Grinders, Cutter

Adams Co., Dubuque, Iowa.
Automatic Mach. Co., Greenfield, Mass.
Becker-Brainard Milling Mach. Co., Hyde Park, Mass.
Brown & Sharpe Mfg. Co., Providence, R. I.
Cincinnati Milling Mach. Co., Cincinnati, O.
Garvin Machine Co., New York.
Norton Emery Wheel Co., Worcester, Mass.
Pratt & Whitney Co., Hartford, Conn.
Rivett-Lock Co., Boston, Mass.
Woodward & Rogers Co., Hartford, Conn.

Grinders, Disc

Besly & Co., Chas. H., Chicago, Ill.
Gorton Mach. Co., Geo., Racine Wis.
Iroquois Mach. Co., New York.
Ransom Mfg. Co., Oshkosh, Wis.

Grinders, Drill

Gorton Mach. Co., Geo., Racine, Wis.
Heald & Son, L. S., Barre, Mass.
Standard Tool Co., Cleveland, O.
Washburn Shops, Worcester, Mass.
Wilmarth & Morman Co., Grand Rapids, Mich.

Grinders, Tool

Barnes Co., B. F., Rockford, Ill.
Barnes Co., W. F. & John, Rockford, Ill.
Barr, H. G., Worcester, Mass.
Brown & Sharpe Mfg. Co., Providence, R. I.
Diamond Mach. Co., Provi., R. I.
Gisholt Mach. Co., Madison, Wis.
Landis Tool Co., Waynesboro, Pa.
Modern Tool Co., Erie, Pa.
Northampton Emery Wheel Co., Leeds, Mass.
Ransom Mfg. Co., Oshkosh, Wis.
Safety Emery Wheel Co., Springfield, O.
Throop Perforating Co., Buffalo, N. Y.
Whitney Mfg. Co., Hartford, Ct.

Grinding Machines
Brown & Sharpe Mfg. Co., Providence, R. I.
Builders' Iron Foundry, Providence, R. I.
Diamond Mach. Co., Prov., R. I.
Fairbanks Co., New York.
Falkenau-Sinclair Co., Phila., Pa.
Goodell-Pratt Co., Greenfield, Mass.
Gorton Mach. Co., Geo., Racine, Wis.
Greenfield Mach. Co., Greenfield, Mass.
Hill, Clarke & Co., Boston, Mass.
Hisey-Wolf Mch. Co., Cincin., O.
Iroquois Mach. Co., New York.
Landis Tool Co., Waynesboro, Pa.
Marshall & Huschart Mchry. Co., Chicago, Ill.
Mechanical Appliance Co., Milwaukee, Wis.
Northampton Emery Wheel Co., Leeds, Mass.
Norton Emery Wheel Co., Worcester, Mass.
Norton Grinding Co., Worcester, Mass.
Prentiss Tool & Supply Co., New York.
Ransom Mfg. Co., Oshkosh, Wis.
Safety Emery Wheel Co., Springfield, Ohio.
Throop Perforating Co., Buffalo, N. Y.
Washburn Shops, Worcester, Mass.
Webster & Perks Tool Co., Springfield, O.
Wilmarth & Morman Co., Grand Rapids, Mich.
Woodward & Rogers Co., Hartford, Conn.

Grinding Wheels
Builders' Iron Foundry, Providence, R. I.
Carborundum Co., Niagara Falls, N. Y.
Diamond Mach. Co., Provi., R. I.
Hampden Cor. Wheel Co., Brightwood, Mass.
Northampton Emery Wheel Co., Leeds, Mass.
Norton Emery Wheel Co., Worcester, Mass.
Safety Emery Wheel Co., Springfield, O.
Whitney Mfg. Co., Hartford, Conn.

Gun Barrel Machinery
Bement, Miles & Co., New York.
Diamond Mach. Co., Provi., R. I.
Niles Tool Works Co., New York.
Pond Mach. Tool Co., New York.
Reed Co., F. E., Worcester, Mass.

Hack Saw Blades and Frames
Diamond Saw & Stamping Wks., Buffalo, N. Y.
Goodell-Pratt Co., Greenfield, Mass.
Hammacher, Schlemmer & Co., New York.
Patterson, Gottfried & Hunter, Ltd., New York.
Starrett Co., L. S., Athol, Mass.
West Haven Mfg. Co., New Haven, Conn.

Hack Saws, Power
Diamond Saw & Stamping Wks., Buffalo, N. Y.
Hoefer Mfg. Co., Freeport, Ill.
West Haven Mfg. Co., New Haven, Conn.

Hammers, Drop
Bement, Miles & Co., New York.
Billings & Spencer Co., Hartford, Conn.
Bliss Co., E. W., Brooklyn, N. Y.
Merrill Bros., Brooklyn, N. Y.
Miner & Peck Mfg. Co., New Haven, Conn.
Mossberg & Granville Mfg. Co., Providence, R. I.
Perkins Mach. Co., Boston, Mass.

Hammers, Pneumatic
Chicago Pneumatic Tool Co., Chicago, Ill.
Cleveland Pneumatic Tool Co., Cleveland, O.
Dallett & Co., Thos. H., Phila., Pa.
Phila. Pneu. Tool Co., Philadelphia, Pa.
Railway Appliances Co., Chicago, Ill.
Rand Drill Co., New York.
Standard Ry. Equip. Co., St. Louis, Mo.
Steel Roll Mangle Co., Chicago, Ill.

Hammers, Power
Scranton & Co., The, New Haven, Conn.

Hammers, Steam
Bement, Miles & Co., New York.
Bethlehem Fdry. & Mach. Co., So. Bethlehem, Pa.
Chambersburg Engr. Co., Chambersburg, Pa.
Cleveland Punch & Shear Wks. Co., Cleveland, O.

Heating and Ventilating Apparatus
Buffalo Forge Co., Buffalo, N. Y.

Heating Machines, Automatic
Am. Gas Furnace Co., New York.

Hoisting and Conveying Machinery
Brown Hoisting Mchry. Co., New York.
Caldwell & Son Co., H. W., Chicago, Ill.
Hunt Co., C. W., West New Brighton, N. Y.
Link Belt Engineering Co., Philadelphia, Pa.
Niles-Bement-Pond Co., New York.

Hoists, Electric
C & C Electric Co., New York.
Hunt Co., C. W., West New Brighton, N. Y.
Northern Engineering Works, Detroit, Mich.
Pawling & Harnischfeger, Milwaukee, Wis.
Sprague Electric Co., New York.

Hoists, Hand
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Yale & Towne Mfg. Co., New York.

Hoists, Pneumatic
Chicago Pneumatic Tool Co., Chicago, Ill.
Cleveland Pneumatic Tool Co., Cleveland, O.
Curtis & Co. Mfg. Co., St. Louis, Mo.
Northern Engineering Wks., Detroit, Mich.
Rand Drill Co., New York.

Igniters, Gas Engine
Dayton Electrical Mfg. Co., Dayton, O.

Indicators, Speed
Starrett Co., L. S., Athol, Mass.

Indicators, Steam
Crosby Steam Gage & Valve Co., Boston, Mass.

Injectors
Lunkenheimer Co., Cincinnati, O.
Sellers & Co., Wm., Phila., Pa.

Inspection and Tests
Hunt Co., Robt. W., Chicago, Ill.

Instruction Schools
See Schools, Correspondence.

Insurance, Boiler
Hartford Steam Boiler Insp. & Ins. Co., Hartford, Conn.

Jacks, Hydraulic
Bethlehem Fdry. & Mch. Co., So. Bethlehem, Pa.
Watson-Stillman Co., New York.

Jack Planer
Armstrong Bros. Tool Co., Chicago, Ill.

Key Seaters
Baker Bros., Toledo, O.
Bement, Miles & Co., New York.
Chattanooga Mchry. Co., Chattanooga, Tenn.
Davis Mach. Co., W. P., Rochester, N. Y.
Mitts & Merrill, Saginaw, Mich.
Whitney Mfg. Co., Hartford, Conn.

Keys, Machine
Standard Gauge Steel Co., Beaver Falls, Pa.
Whitney Mfg. Co., Hartford, Ct.

Lamps, Arc
General Electric Co., N. Y. City.
Western Electric Co., Chicago, Ill.
Westinghouse Elec. & Mfg. Co., Pittsburgh, Pa.

Lathe Attachments
National Machine Tool Co., Cincinnati, O.

Lathe Dogs
Armstrong Bros. Tool Co., Chicago, Ill.
Besly & Co., Chas. H., Chicago, Ill.
Le Count, Wm. G., So. Norwalk, Conn.
Pratt & Whitney Co., Hartford, Conn.
Tindel-Morris Co., Eddystone, Pa.

Lathes
American Tool Wks. Co., Cin., O.
Automatic Mach. Co., Greenfield, Mass.
Barnes Co., B. F., Rockford, Ill.
Barnes Co., W. F. & John, Rockford, Ill.
Bement, Miles & Co., New York.
Blount & Co., J. G., Everett, Mass.
Bradford Mach. Tool Co., Cin., O.
Brown & Zortman Mchry. Co., Pittsburg, Pa.
Bullard Mach. Tool Co., Bridgeport, Conn.
Davis Mach. Co., W. P., Rochester, N. Y.
Diamond Machine Co., Prov., R. I.
Draper Mach. Tool Co., Worcester, Mass.
Fairbanks Co., New York.
Fay & Scott, Dexter, Me.
Flather & Co., Nashua, N. H.
Garvin Mach. Co., New York.
Greaves, Klusman Co., Cincin., O.
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Hendey Mach. Co., Torrington, Ct.
Hill, Clarke & Co., Boston, Mass.
Le Blond Mach. Tool Co., R. K., Cincinnati, O.
Lodge & Shipley Mch. Tool Co., Cincinnati, O.
McCabe, J. J., New York.
Marshall & Huschart Mchry. Co., Chicago, Ill.
Milwaukee Machine Tool Co., Milwaukee, Wis.
New Haven Mfg. Co., New Haven, Conn.
Niles Tool Works Co., New York.
Pond Mach. Tool Co., New York.
Pratt & Whitney Co., Hartford, Conn.
Prentiss Tool & Supply Co., New York.
Reed Co., F. E., Worcester, Mass.
Schumacher & Boye, Cincinnati, Ohio.
Sebastian Lathe Co., Cincin., O.
Seneca Falls Mfg. Co., Seneca Falls, N. Y.
Washburn Shops, Worcester, Mass.

Lathes, Automatic Screw-Threading
Automatic Machine Co., Bridgeport, Conn.

Lathes, Bench
Faneuil Watch Tool Co., Boston, Mass.
Loop-Lock Mach. Co., Waltham, Mass.
Waltham Watch Tool Co., Springfield, Mass.

Lathes, Boring
Streit Mach. Co., A., Cincin., O.

Letters, Pattern
Brim, A. W., Seneca Falls, N. Y.
Butler, A. G., N. Y. City.

Levels
Mass. Tool Co., Greenfield, Mass.
Starrett Co., L. S., Athol, Mass.

Lockers, Clothes
Merritt & Co., Philadelphia, Pa.
Narragansett Mach. Co., Providence, R. I.

Locomotives, Shop
Hunt Co., C. W., West New Brighton, N. Y.

Lubricants
Besly & Co., Chas. H., Chicago, Ill.
Dixon Crucible Co., Jos., Jersey City, N. J.
Lubriphite Co., Jersey City, N. J.

Lubricators
Besly & Co., Chas. H., Chicago, Ill.
Bowen Mfg. Co., Auburn, N. Y.
Crane Co., Chicago, Ill.
Lubriphite Co., Jersey City, N. J.
Lunkenheimer Co., Cincinnati, O.

Machine Screws
Atlantic Mach. Screw Co., Boston, Mass.
Worcester Mach. Screw Co., Worcester, Mass.

Machinery Builders, Special
American Fdry. & Mach. Co., Hanover, Pa.
Blanchard Mach. Co., The, Boston, Mass.
Eclipse Mach. Co., Cleveland, O.
Fawcus Mch. Co., Pittsburgh, Pa.
Hart, Fredk., Poughkeepsie, N. Y.
Hoefer Mfg. Co., Freeport, Ill.
Pratt & Whitney Co., Hartford, Conn.
Simonds Mfg. Co., Pittsburgh, Pa.
Wade Mach. Works, Walter H., Boston, Mass.
Woodward & Rogers Co., Hartford, Conn.

Machinists' Small Tools
Besly & Co., Chas. H., Chicago, Ill.
Billings & Spencer Co., Hartford, Conn.
Brown & Sharpe Mfg. Co., Providence, R. I.
Cleveland Twist Drill Co., Cleveland, O.
Hammacher, Schlemmer & Co., New York.
McCrosky, F. B., Cincinnati, O.
Mass. Tool Co., Greenfield, Mass.
Patterson, Gottfried & Hunter, Ltd., New York.
Sawyer Tool Mfg. Co., Fitchburg, Mass.
Slocomb Co., J. T., Provi., R. I.
Standard Tool Co., Cleveland, O.
Starrett Co., L. S., Athol, Mass.
Wyke & Co., J., E. Boston, Mass.

Machinists' Supplies
Hammacher, Schlemmer & Co., New York.
Patterson, Gottfried & Hunter, Ltd., New York.

Mandrels, Expanding
Nicholson & Son, W. H., Wilkesbarre, Pa.

Mandrels, Solid
Cleveland Twist Drill Co., Cleveland, O.
Morse Twist Drill & Mach. Co., New Bedford, Mass.
Rogers, John M., Boat, Gage & Drill Works, Gloucester City, N. J.
Standard Tool Co., Cleveland, O.

Measuring Machines
Rogers, John M., Boat, Gage & Drill Works, Gloucester City, N. J.

Metal, Bearing
Besly & Co., Chas. H., Chicago, Ill.
Patterson, Gottfried & Hunter, Ltd., New York.

Metal, Perforated
Throop Perforating Co., Buffalo, N. Y.

Micrometer Calipers
Brown & Sharpe Mfg. Co., Providence, R. I.
Sawyer Tool Mfg. Co., Fitchburg, Mass.
Slocomb Co., J. T., Providence, R. I.
Starrett Co., L. S., Athol, Mass.

Milling Attachments
The Adams Co., Dubuque, Iowa.
Becker-Brainard Milling Mach. Co., Hyde Park, Mass.
Brown & Sharpe Mfg. Co., Providence, R. I.
Cincinnati Milling Mach. Co., Cincinnati, O.
Whitney Mfg. Co., Hartford, Conn.

Milling Machines, Bench
Faneuil Watch Tool Co., Boston, Mass.
Hill, Clarke & Co., Boston, Mass.
Loop-Lock Mach. Co., Waltham, Mass.
Waltham Watch Tool Co., Springfield, Mass.

Milling Machines, Horizontal
Adams Co., Dubuque, Iowa.
Beaman & Smith Co., Prov., R. I.
Becker-Brainard Milling Mach. Co., Hyde Park, Mass.
Bement, Miles & Co., New York.
Hendey Mach. Co., Torrington, Ct.
Ingersoll Mill. Mach. Co., Rockford, Ill.
Newton Mach. Tool Wks., Philadelphia, Pa.
Niles Tool Works Co., New York.
Pratt & Whitney Co., Hartford, Conn.

Milling Machines, Portable
Underwood & Co., H. B., Philadelphia, Pa.

Milling Machines, Plain
American Tool Wks. Co., Cin., O.
Becker-Brainard Milling Mach. Co., Hyde Park, Mass.
Bement, Miles & Co., New York.
Brown & Sharpe Mfg. Co., Providence, R. I.
Cincinnati Milling Mach. Co., Cincinnati, O.
Fairbanks Co., New York.
Garvin Mach. Co., New York.
Hendey Mach. Co., Torrington, Ct.
Hill, Clarke & Co., Boston, Mass.
Kempsmith Mfg. Co., Milwaukee, Wis.
Le Blond Mach. Tool Co., R. K., Cincinnati, O.
Marshall & Huschart Mchry. Co., Chicago, Ill.
McCabe, J. J., New York.
Owen Mach. Tool Co., Springfield, Ohio.
Prentiss Tool & Supply Co., New York.
Whitney Mfg. Co., Hartford, Ct.

Milling Machines, Universal
American Tool Wks. Co., Cin., O.
Becker-Brainard Milling Mach. Co., Hyde Park, Mass.
Bement, Miles & Co., New York.
Brown & Sharpe Mfg. Co., Providence, R. I.
Cincinnati Milling Mach. Co., Cincinnati, O.
Fairbanks Co., New York.
Garvin Mach. Co., New York.
Hendey Mach. Co., Torrington, Ct.
Hill, Clarke & Co., Boston, Mass.
Kempsmith Mfg. Co., Milwaukee, Wis.
Le Blond Mach. Tool Co., R. K., Cincinnati, O.
Marshall & Huschart Mchry. Co., Chicago, Ill.
McCabe, J. J., New York.
Niles Tool Works Co., New York.
Owen Mach. Tool Co., Springfield, Ohio.
Prentiss Tool & Supply Co., New York.
Waltham Watch Tool Co., Springfield, Mass.

Milling Machines, Vertical
Becker-Brainard Milling Mach. Co., Hyde Park, Mass.
Bement, Miles & Co., New York.
Brown & Sharpe Mfg. Co., Providence, R. I.
Garvin Mach. Co., New York.
Ingersoll Mill. Mach. Co., Rockford, Ill.
Newton Mch. Tool Works, Philadelphia, Pa.
Niles Tool Works Co., New York.
Owen Mach. Tool Co., Springfield, Ohio.
Pratt & Whitney Co., Hartford, Conn.
Quint, A. D., Hartford, Conn.

Milling Tools, Adjustable
Geometric Drill Co., New Haven, Conn.
Rogers, Boat, Gage & Drill Wks., John M., Gloucester City, N. J.

Molding Machines
Adams Co., The, Dubuque, Iowa.
American Foundry & Mach. Co., Hanover, Pa.
Tabor Mfg. Co., Philadelphia, Pa.
Webster & Perks Tool Co., Springfield, O.

Molds, Hammer and Vise Jaw
Field, Chas. H., Providence, R. I.

Motors, Electric
C & C Electric Co., New York.
Christensen Engr. Co., Milwaukee, Wis.
Commercial Electric Co., Indianapolis, Ind.
Crocker-Wheeler Co., Ampere, N. J.
Eck Dynamo & Motor Wks., Belleville, N. J.
General Electric Co., New York.
Jantz & Leist Elec. Co., Cin., O.
Mechanical Appliance Co., Milwaukee, Wis.
Milwaukee Elec. Co., Milwaukee, Wis.
Northern Elec. Mfg. Co., Madison, Wis.
Robbins & Myers Co., Springfield, Ohio.
Sprague Electric Co., New York.
Star Dynamo Works, Jefferson City, Mo.
Storey Motor & Electric Co., Harrison, N. J.
Triumph Elec. Co., Cincinnati, O.
Western Electric Co., Chicago, Ill.
Westinghouse Elec. & Mfg. Co., Pittsburgh, Pa.

Name Plates
Franklin Mfg. Co., Syracuse, N. Y.
Turner Brass Works, Chicago, Ill.

Nut Tappers
See Bolt and Nut Machinery.

Oil Cups and Covers
Bay State Stamping Works, Worcester, Mass.
Besly & Co., Chas. H., Chicago, Ill.
Bowen Mfg. Co., Auburn, N. Y.
Crane Co., Chicago, Ill.
Lunkenheimer Co., Cincinnati, O.
Tucker, W. W. & C. F., Hartford, Conn.
The Winkley Co., Hartford, Conn.

Oils
Besly & Co., Chas. H., Chicago, Ill.
Harris Oil Co., A. W., Provi., R. I.

Oils, Slushing
Harris Oil Co., A. W., Provi., R. I.

Oil Stones
Pike Mfg. Co., Pike Station, N. H.

Packing, Steam Joint
Jenkins Bros., New York.
N. Y. Belting & Packing Co., New York.
Peerless Rubber Mfg. Co., New York.

Pans, Lathe
New Britain Mch. Co., New Britain, Conn.

Pans, Shop
Kilbourne & Jacobs Mfg. Co., Columbus, O.

Patents
Baldwin, Davidson & Wight, Washington, D. C.
Stevens & Co., Milo B., Washington, D. C.

Pattern Shop Machinery
American Mchry. Co., Grand Rapids, Mich.
Baker Bros., Toledo, O.
Brown & Zortman Mchry. Co., Pittsburg, Pa.
Fairbanks Co., New York.
Fay & Scott, Dexter, Me.
Field, Chas. H., Providence, R. I.
Greaves, Klusman & Co., Cin., O.
Prentiss Tool & Supply Co., New York.
Washburn Shops, Worcester, Mass.

Patterns, Wood
Hartford Pattern & Model Co., Hartford, Conn.

Pencils
Keuffel & Esser Co., New York.

Pinion Cutters
Loop-Lock Mach. Co., Waltham, Mass.

Pipe and Fittings
Crane Co., Chicago, Ill.

Pipe Cutting and Threading Machines
Bignall & Keeler Mfg. Co., Edwardsville, Ill.
Curtis & Curtis Co., Bridgeport, Conn.
Merrell Mfg. Co., Toledo, O.
Oster Mfg. Co., Cleveland, O.
Reed Mfg. Co., Erie, Pa.
Saunders' Sons, D., Yonkers, N. Y.
Wells Bros. Co., Greenfield, Mass.

Pipe Fitters' Tools
Cleveland Twist Drill Co., Cleveland, O.
Saunders' Sons, D., Yonkers, N. Y.
Standard Tool Co., Cleveland, O.

Planers
American Tool Wks. Co., Cin., O.
Belmer Mach. Tool Co., Cin., O.
Bement, Miles & Co., New York.
Betts Mach. Co., Wilmington, Del.
Cincinnati Planer Co., Cincin., O.
Detrick & Harvey Mch. Co., Baltimore, Md.
Fairbanks Co., New York.
Flather Planer Co., Mark, Nashua, N. H.
Garvin Mach. Co., New York.
Gray Co., G. A., Cincinnati, O.
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Hendey Mach. Co., Torrington, Ct.
Hill, Clarke & Co., Boston, Mass.
McCabe, J. J., New York.
Niles Tool Works Co., New York.
New Haven Mfg. Co., New Haven, Conn.

Planers—*Continued*
Pond Mach. Tool Co., New York.
Prentiss Tool & Supply Co., New York.
Sellers & Co., Wm., Phila., Pa.
Whitcomb Mfg. Co., Worcester, Mass.
Woodward & Powell Planer Co., Worcester, Mass.

Planers, Portable
Underwood & Co., H. B., Philadelphia, Pa.

Planers, Rotary
Bement, Miles & Co., New York.
Cleveland Punch & Shear Works, Cleveland, O.
Newton Mach. Tool Wks., Philadelphia, Pa.
Pond Mach. Tool Co., New York.
Underwood & Co., H. B., Philadelphia, Pa.

Presses, Hand
Perkins Mach. Co., So. Boston, Mass.

Presses, Hydraulic
Watson-Stillman Co., New York.

Presses, Power
Automatic Mach. Co., Bridgeport, Conn.
Bethlehem Fdry. & Mch. Co., So. Bethlehem, Pa.
B'ss Co., E. W., Brooklyn, N. Y.
Chambersburg Engr. Co., Chambersburg, Pa.
Dellvouk & George, Chicago, Ill.
Fairbanks Co., New York.
Mossberg & Granville Mfg. Co., Providence, R. I.
Perkins Mach. Co., So. Boston, Mass.
Prentiss Tool & Supply Co., New York.
Wold & Co., Torris Chicago, Ill.

Profilers
Garvin Mach. Co., New York.
Pratt & Whitney Co., Hartford, Conn.

Pulleys
American Pulley Co., Phila., Pa.
Caldwell & Son Co., H. W., Chicago, Ill.
Cresson Co., Geo. V., Phila., Pa.
Federal Mfg. Co., Cleveland, O.
Howard Iron Wks., Buffalo, N. Y.
Oneida Steel Pulley Co., Oneida, N. Y.
Patterson, Gottfried & Hunter, Ltd., New York.
Reeves Pulley Co., Columbus, Ind.
The Xylotite Co., Cincinnati, O.

Pulleys, Friction Cone
Evans Friction Cone Co., Boston, Mass.

Pulleys, Speed Changing
Speed Changing Pulley Co., Indianapolis, Ind.

Pulley Turning and Boring Machines
Harrington, Son & Co., Edwin, Philadelphia, Pa.
New Haven Mfg. Co., New Haven, Conn.
Niles Tool Works Co., New York.
Streit Mach. Co., A., Cincin., O.

Pumps, Hydraulic
Watson-Stillman Co., New York.

Punches, Hydraulic
Bement, Miles & Co., New York.
Bethlehem Fdry. & Mch. Co., So. Bethlehem, Pa.
Watson-Stillman Co., New York.

Punches, Power
Bliss Co., E. W., Brooklyn, N. Y.
Bremer Mach. & Tool Co., Kalamazoo, Mich.
Buffalo Forge Co., Buffalo, N. Y.
Cincinnati Punch & Shear Co., Cincinnati, O.
Cleveland Punch & Shear Wks. Co., Cleveland, O.
Hilles & Jones Co., Wilmington, Del.
Long & Allstatter Co., Hamilton, Ohio.
Perkins Mach. Co., S. Boston, Mass.
Reade Mchry. Co., Cleveland, O.

Rack Cutting Machines
Fellows Gear Shaper Co., Springfield, Vt.
Le Blond Mach. Tool Co., R. K., Cincinnati, O.
Reed Co., F. E., Worcester, Mass.

Racks, Cut
Fellows Gear Shaper Co., Springfield, Vt.
Nuttall Co., R. D., Pittsburgh, Pa.
Simonds Mfg. Co., Pittsburgh, Pa.
Standard Gauge Steel Co., Beaver Falls, Pa.

Racks, Tool
New Britain Mach. Co., New Britain, Conn.

Reamers
Cleveland Twist Drill Co., Cleveland, O.
Clough, R. M., Tolland, Conn.
McCrosky, F. B., Cincinnati, O.
Morse Twist Drill & Mach. Co., New Bedford, Mass.
New Process Twist Drill Co., Taunton, Mass.
Pratt & Whitney Co., Hartford, Conn.
Rogers, John M., Boat, Gage & Drill Works, Gloucester City, N. J.
Standard Tool Co., Cleveland, O.
Wells Bros. Co., Greenfield, Mass.

Reaming Stands
Flather Planer Co., Mark, Nashua, N. H.

Rheostats
Cutler-Hammer Mfg. Co., Milwaukee, Wis.

Riveters, Pneumatic
Bement, Miles & Co., New York.
Cleveland Pneumatic Tool Co., Cleveland, O.
Philadelphia Pneumatic Tool Co., Philadelphia, Pa.
Railway Appliances Co., Chicago, Ill.
Rand Drill Co., New York.
Standard Ry. Equip. Co., St. Louis, Mo.

Riveters, Hydraulic
Bement, Miles & Co., New York.
Watson-Stillman Co., New York.

Riveting Machines
Bement, Miles & Co., New York.
Bethlehem Foundry & Mach. Co., So. Bethlehem, Pa.
Chambersburg Engr. Co., Chambersburg, Pa.
Long & Allstatter Co., Hamilton, Ohio.
Perkins Mach. Co., So. Boston, Mass.

Roller and Ball Bearings
Ball Bearing Co., Philadel., Pa.
Bantam Mfg. Co., Bantam, Conn.
Mossberg & Granville Mfg. Co., Providence, R. I.

Rolling Mill Machinery
Cleveland Punch & Shear Wks. Co., Cleveland, O.
Hilles & Jones Co., Wilmington, Del.
Mossberg & Granville Mfg. Co., Providence, R. I.
Pratt & Whitney Co., Hartford, Conn.

Rubber Goods, Mechanical
N. Y. Belting & Packing Co., New York.
Peerless Rubber Mfg. Co., New York.

Rules, Steel
Mass. Tool Co., Greenfield, Mass.
Sawyer Tool Co., Fitchburg, Mass.
Slocomb Co., J. T., Provi., R. I.

Safety Valves, Pop
Crane Co., Chicago, Ill.
Crosby Steam Gage & Valve Co., Boston, Mass.
Lunkenheimer Co., Cincinnati, O.

Sand Blast Apparatus
Paxson Co., J. W., Philadel., Pa.

Sand Mixing Machines
Hanna, E. E., Chicago, Ill.
Obermayer Co., S., Cincinnati, O.

Sawing Machines, Metal
Cleveland Punch & Shear Works Co., Cleveland, O.
Cochrane-Bly Mach. Works, Rochester, N. Y.
Newton Mach. Tool Works, Philadelphia, Pa.
Pratt & Whitney Co., Hartford, Conn.
Reade Mchry. Co., Cleveland, O.
West Haven Mfg. Co., New Haven, Conn.

Sawing Machines, Wood
Brown & Zortman Mchry. Co., Pittsburg, Pa.

Schools, Correspondence
Amer. School of Correspondence, Chicago, Ill.
Consolidated Schools, N. Y. City.
International Correspond. Schools, Scranton, Pa.

Schools, Technical
Mich. College of Mines, Houghton, Mich.
State College of Ky., Lexington, Ky.

Screw Machines, Automatic
Brown & Sharpe Mfg. Co., Providence, R. I.
Cleveland Automatic Mach. Co., Cleveland, O.
Dreses Mach. Tool Co., Cincin., O.
Marshall & Huschart Mchry. Co., Chicago, Ill.
Windsor Mach. Co., Windsor, Vt.

Screw Machines, Hand
Brown & Sharpe Mfg. Co., Providence, R. I.
Cleveland Automatic Mach. Co., Cleveland, O.
Draper Mach. Tool Co., Worcester, Mass.
Garvin Mach. Co., New York.
Jones & Lamson Mch. Co., Springfield, Vt.
Pearson Mach. Co., Chicago, Ill.
Potter & Johnston Mach. Co., Pawtucket, R. I.
Pratt & Whitney Co., Hartford, Conn.
Warner & Swasey Co., Cleveland, Ohio.
Windsor Mach. Co., Windsor, Vt.

Screw Machinery, Wood and Lag
Baker Bros., Toledo, Ohio.
Cook Co., Asa S., Hartford, Conn.

Screw Plates
Besly & Co., Chas. H., Chicago, Ill.
Carpenter Tap & Die Co., J. M., Pawtucket, R. I.
Card Mfg. Co., S. W., Mansfield, Mass.
Morse Twist Drill & Mach. Co., New Bedford, Mass.
Oster Mfg. Co., Cleveland, O.
Wells Bros. Co., Greenfield, Mass.

Second Hand Machinery
Baird Machy. Co., Pittsburg, Pa.
Bowler & Co., Geo. H., Cleveland, Ohio.
Brown & Zortman Mchry. Co., Pittsburgh, Pa.
Carlin Mchry. & Supply Co., Allegheny, Pa.
Fairbanks Co., New York.
Fairbanks Co., Philadelphia, Pa.
Garvin Mch. Co., New York.
Hill, Clarke & Co., Boston, Mass.
Marshall & Huschart Mchry. Co., Chicago, Ill.
McCabe, J. J., New York.
Niles-Bement-Pond Co. New York.
Packard Machinery Co., O. L., Chicago, Ill.
Pratt & Whitney Co., Hartford, Conn.
Prentiss Tool & Supply Co., New York.
Toomey, Frank, Philadelphia, Pa.
Wickes Bros., New York.
Wormer Machy. Co., C. C., Detroit, Mich.

Separators, Oil
American Tool & Mach. Co., Boston, Mass.

Shapers
American Tool Wks. Co., Cin., O.
Bement, Miles & Co., New York.
Cincinnati Shaper Co., Cincin., O.
Fairbanks Co., New York.
Flather Planer Co., Mark, Nashua, N. H.
Garvin Mach. Co., New York.
Gould & Eberhardt, Newark, N. J.
Hendey Mch. Co., Torrington, Ct.
Hill, Clarke & Co., Boston, Mass.
Kelly Co., R. A., Xenia, Ohio.
Marshall & Huschart Mchry. Co., Chicago, Ill.
New Haven Mfg. Co., New Haven, Conn.
Niles Tool Works Co., New York.
Perkins Mach. Co., So. Boston, Mass.
Potter & Johnston Mach. Co., Pawtucket, R. I.
Prentiss Tool & Supply Co., New York.
Steptoe Shaper Co., John, Cincinnati, O.

Shears, Power
Bethlehem Fdry. & Mch. Co., So. Bethlehem, Pa.
Bliss Co., E. W., Brooklyn, N. Y.
Bremer Mach. & Tool Co., Kalamazoo, Mich.
Buffalo Forge Co., Buffalo, N. Y.
Cincinnati Punch & Shear Co., Cincinnati, O.
Cleveland Punch & Shear Works, Cleveland, O.
Hilles & Jones Co., Wilmington, Del.
Long & Allstatter Co., Hamilton, Ohio.
Perkins Mach. Co., So. Boston, Mass.
Reade Mchry. Co., Cleveland, O.

Shears, Rotary
Bethlehem Foundry & Mach. Co., So. Bethlehem, Pa.
Detrick & Harvey Mach. Co., Baltimore, Md.
Perkins Mach. Co., So. Boston, Mass.

Shelving, Shop
New Britain Mach. Co., New Britain, Conn.

Slide Rests
Reed Co., F. E., Worcester, Mass.

Slotters
Baker Bros., Toledo, Ohio.
Barr, H. G., Worcester, Mass.
Bement, Miles & Co., New York.
Betts Mach. Co., Wilmington, Del.
Garvin Mach. Co., New York.
New Haven Mfg. Co., New Haven, Conn.
Newton Mach. Tool Wks., Philadelphia, Pa.
Niles Tool Works Co., New York.

Sockets and Sleeves
New Process Twist Drill Co., Taunton, Mass.

Sprocket Chains
See Driving Chains.

Stampings, Sheet Steel
Federal Mfg. Co., Cleveland, O.

Stamps, Steel
Schwerdtle Stamp Co., Bridgeport, Conn.

Steel, Machinery
Boker & Co., Hermann, New York.
Patriarche & Bell, New York.
Ward & Son, Edgar T., Boston, Mass.

Steel, Sheet
Federal Mfg. Co., Cleveland, O.
Ward & Son, Edgar T., Boston, Mass.

Steel, Tool
Boker & Co., Hermann, New York.
Firth-Sterling Steel Co., Demmler, Pa.
Patriarche & Bell, New York.
Patterson, Gottfried & Hunter, Ltd., New York.

Stones, Oil
Pike Mfg. Co., Pike Station, N. H.

Straightener, Hydraulic
Bement, Miles & Co., New York.
Watson-Stillman Co., New York.

Swaging Machines
Excelsior Needle Co., Torrington, Conn.
Mossberg & Granville Mfg. Co., Providence, R. I.

Switchboards
C & C Electric Co., New York.
Triumph Elec. Co., Cincinnati, O.
Western Electric Co., Chicago, Ill.
Westinghouse Elec. & Mfg. Co., Pittsburg, Pa.

Tapping Machines and Attachments
Baker Bros., Toledo, O.
The Beaman & Smith Co., Providence, R. I.
Bickford Drill & Tool Co., Cin., O.
Cincinnati Mach. Tool Co., Cincinnati, O.
Errington, F. A., N. Y. City.
Fosdick Mach. Tool Co., Cin., O.
Garvin Mach. Co., New York.
Geometric Drill Co., New Haven, Conn.
Modern Tool Co., Erie, Pa.
Pratt & Whitney Co., Hartford, Conn.

Tapping Machines and Attachments—*Continued*
Quint, A. D., Hartford, Conn.
Webster & Perks Tool Co., Springfield, O.
Whitney Mfg. Co., Hartford, Conn.
Woodward & Rogers Co., Hartford, Conn.

Taps and Dies
field, Mass.
Besly & Co., Chas. H., Chicago, Ill.
Card Mfg. Co., S. W., Mansfield, Mass.
Carpenter Tap & Die Co., J. M., Pawtucket, R. I.
Cleveland Twist Drill Co., Cleveland, O.
Crane Co., Chicago, Ill.
Geometric Drill Co., New Haven, Conn.
Hammacher, Schlemmer & Co., New York.
Morse Twist Drill & Mach. Co., New Bedford, Mass.
Oster Mfg. Co., Cleveland, O.
Patterson, Gottfried & Hunter, Ltd., New York.
Pratt & Whitney Co., Hartford, Conn.
Standard Tool Co., Cleveland, O.
Webster & Perks Tool Co., Springfield, O.
Wells Bros. Co., Greenfield, Mass.

Taps, Collapsing
Geometric Drill Co., New Haven, Conn.

Telephone System
Clark Auto. Telephone Switch Board Co., Providence, R. I.

Thread Cutting Tools
Besly & Co., Chas. H., Chicago, Ill.
Oster Mfg. Co., Cleveland, O.
Pratt & Whitney Co., Hartford, Conn.
Rivett-Dock Co., Boston, Mass.

Tool Holders
Armstrong Bros. Tool Co., Chicago, Ill.
Hoggson & Pettis Mfg. Co., New Haven, Conn.
McCrosky, F. B., Cincinnati, O.
O. K. Tool Holder Co., Shelton, Conn.

Tools, Small
See Machinists' Small Tools.

Tracing Cloth
Keuffel & Esser Co., New York.
Hardtmuth, L. & C., New York.

Transmission Machinery
American Pulley Co., Phila., Pa.
Caldwell & Son Co., H. W., Chicago, Ill.
Case Mfg. Co., Columbus, O.
Cresson & Co., Geo. V., Phila., Pa.
Federal Mfg. Co., Cleveland, O.
Link-Belt Engineering Co., Philadelphia, Pa.
National Machine Tool Co., Cincinnati, O.
Oneida Steel Pulley Co., Oneida, N. Y.
Patterson, Gottfried & Hunter, Ltd., New York.
Reeves Pulley Co., Columbus, Ind.

Trimmers, Wood
American Mchry. Co., Grand Rapids, Mich.
Carlin Mchry. & Supply Co., Allegheny, Pa.
Washburn Shops, Worcester, Mass.

Trolleys and Tramways
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Hunt Co., C. W., West New Brighton, N. Y.
Link Belt Engineering Co., Philadelphia, Pa.
Yale & Towne Mfg. Co., New York.

Tubing, Steel
Shelby Steel Tube Co., Pittsburgh, Pa.

Turret Machines
American Tool & Mach. Co., Boston, Mass.
Automatic Mach. Co., Greenfield, Mass.
Bradford Mach. Tool Co., Cincinnati, O.
Brown & Sharpe Mfg. Co., Providence, R. I.
Bullard Mach. Tool Co., Bridgeport, Conn.
Dreses Mach. Tool Co., Cincin., O.
Flather & Co., Nashua, N. H.

Turret Machines—*Continued*
Garvin Mach. Co., New York.
Gisholt Mch. Co., Madison, Wis.
Hill, Clarke & Co., Boston, Mass.
Jones & Lamson Mch. Co., Springfield, Vt.
Le Blond Mach. Tool Co., R. K., Cincinnati, O.
Lodge & Shipley Mach. Tool Co., Cincinnati, O.
Milwaukee Mach. Tool Co., Milwaukee, Wis.
Niles Tool Works Co., New York.
Pearson Mach. Co., Chicago, Ill.
Potter & Johnston Mach. Co., Pawtucket, R. I.
Warner & Swasey Co., Cleveland, Ohio.
Windsor Mach. Co., Windsor, Vt.

Turrets, Carriage
Fay & Scott, Dexter, Me.

Twist Drills
Cleveland Twist Drill Co., Cleveland, O.
Hammacher, Schlemmer & Co., New York.
Morse Twist Drill & M. Co., New Bedford, Mass.
New Process Twist Drill Co., Taunton, Mass.
Patterson, Gottfried & Hunter, Ltd., New York.
Standard Tool Co., Cleveland, O.

Universal Joints
Baush Machine Tool Co., Springfield, Mass.
Gray & Prior Mch. Co., Hartford, Conn.
Vanderbeek Tool Wks., Hartford, Conn.

Valves
See Steam Fittings.

Vises, Drill
Graham Mfg. Co., Provi., R. I.
Hopkinson Mach. Works, Springfield, Mass.
Jacobson Mach. Mfg. Co., Warren, Pa.

Vises, Metal Workers'
Hammacher, Schlemmer & Co., New York.
Hanna, E. E., Chicago, Ill.
Howard Iron Wks., Buffalo, N. Y.
Jacobson Mach. Mfg. Co., Warren, Pa.
Parker Co., Chas., Meriden, Conn.
Prentiss Vise Co., New York.
Reed Mfg. Co., Erie, Pa.
Walworth Mfg. Co., Boston, Mass.

Vises, Pipe
Curtis & Curtis Co., Bridgeport, Conn.
Prentiss Vise Co., New York.
Saunders'Sons, D., Yonkers, N. Y.
Walworth Mfg. Co., Boston, Mass.

Vises, Planer and Shaper
Cincinnati Planer Co., Cincin., O.
Hendey Mach. Co., Torrington, Ct.
Pratt & Whitney Co., Hartford, Conn.

Vises, Wood Workers'
Emmert Mfg. Co., Waynesboro, Pa.
Hammacher, Schlemmer & Co., New York.
Wyman & Gordon, Worcester, Mass.

Welding Machines
Long & Allstatter Co., Hamilton, Ohio.

Wire-Drawing Machinery
Iroquois Mach. Co., New York.
Mossberg & Granville Mfg. Co., Providence, R. I.

Wire-Forming Machinery
Automatic Mach. Co., Bridgeport, Conn.

Wire-Straightening Machinery
Hoefer Mfg. Co., Freeport, Ill.

Worm Hobbing Machines
Pratt & Whitney Co., Hartford, Conn.

Worm Milling Machines
Cleveland Automatic Mach. Co., Cleveland, O.
Pratt & Whitney Co., Hartford, Conn.

Wrenches
Coes Wrench Co., Worcester, Mass.

Wrenches, Drop Forged
Billings & Spencer Co., Hartford, Conn.

Hunt's Measurements and Drawings—I.

BY JOHN RANDOL.

The C. W. Hunt Company, West New Brighton, Staten Island, N. Y., is regularly using what amounts to a new method of making measurements in machine work.

Pieces of the more simple forms, such as studs, shafts and ordinary lathe work on the arbor or on its own centers, are measured in the usual way, and the drawings from which these simple pieces are made have dimensions given in the usual manner.

For frames and other pieces which require both planer and horizontal boring mill cuts, and for vertical spindle boring-mill work which has non-concentric finished surfaces, the Hunt methods of machining and of writing the dimensions on the drawings are used, involving applications of what is called the "Datum line," or line of departure, and the measurements are made in the shop, not on and of the machine part under construction, but by

EXPLANATION OF FINISH MARKS.

All unmarked surfaces left rough as received, but "r" is used in doubtful cases.

rs = "Smooth or emery wheel the rough."
f = "Ordinary machine shop finish."
fr = "A roughing cut only to be taken."
fs = "Extra fine machine shop work."
fss = "Polish or draw-file the work"

WORKING LIMITS.

The permissible shop variation from the dimension figure on the drawing is placed after it, thus: $2\ ^{+.001}_{-.002}$

Dimensions not followed by a limiting decimal are to be worked to with reasonable shop accuracy.

TABLE 1.

(This explanation appears at the upper left-hand corner of all the C. W. Hunt Company detail drawings.)

applying steel rod length-gages to some parts of the machine tool being used, so as to accurately locate the cut without applying any measuring implement to the actual piece itself.

The drawing must therefore tell the workman the mark which distinguishes the length measures which he is to use in setting the machine spindle or the cutting tool, so as to bring the cut in proper relation to some rough casting surface, or to some previously made cut, instead of specifying the actual measurements.

A simple example will make this method of measuring clear, as it is now common practice to locate some finishing cuts in this way where ordinary machine tools are used, and the drawings show finished dimensions in the usual manner. Supposing a piece is to be planed so as to have a flat base, and two surfaces on the other side, respectively 1 inch and 1½ inches above the base, and that the workman who is to plane this piece has accurately finished hard steel gage blocks, one 1 inch and one 1½ inches high. First the base is planed to make the rough surface of the top stand right, then the base is placed on the planer table, and the workman sets his tools for the finishing cuts, not by measuring the piece itself, but to his hardened blocks, set on the planer table. This makes the top of the planer table the "datum" line or surface, and the required dimensions are obtained without measuring the work itself. It is now common to provide accurate plug and ring gages and distance blocks, all hardened and ground to the micrometer, and the modern toolmaker sets his tools by use of these gages and blocks so far as may be.

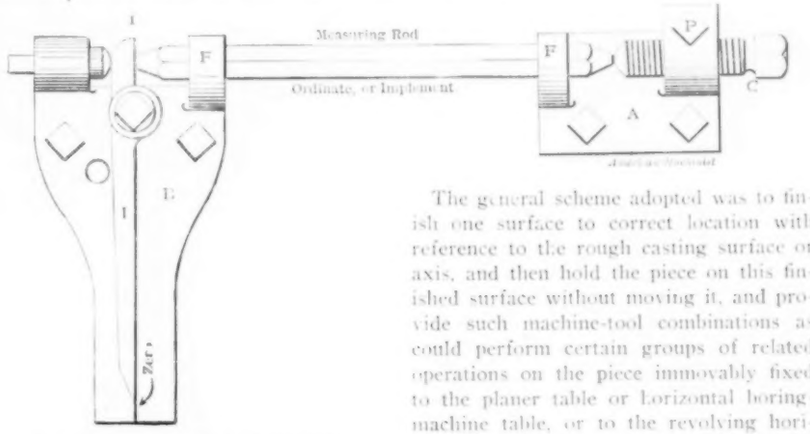


FIG. 1. DIAGRAM OF GAGE IN USE.

The general scheme adopted was to finish one surface to correct location with reference to the rough casting surface or axis, and then hold the piece on this finished surface without moving it, and provide such machine-tool combinations as could perform certain groups of related operations on the piece immovably fixed to the planer table or horizontal boring-machine table, or to the revolving horizontal face of the vertical spindle boring-mill face-plate.

The designs of the winding engines and electric locomotives were made to suit the combined machine tools, and the machine tools were made to suit the new work forms, and when the best average of these two-fold concessions appeared to have been found, the new machine tools shown in the illustrations were ordered and installed. The horizontal spindle boring machine (by the Betts Company) was found to require no additions. A planer, 62

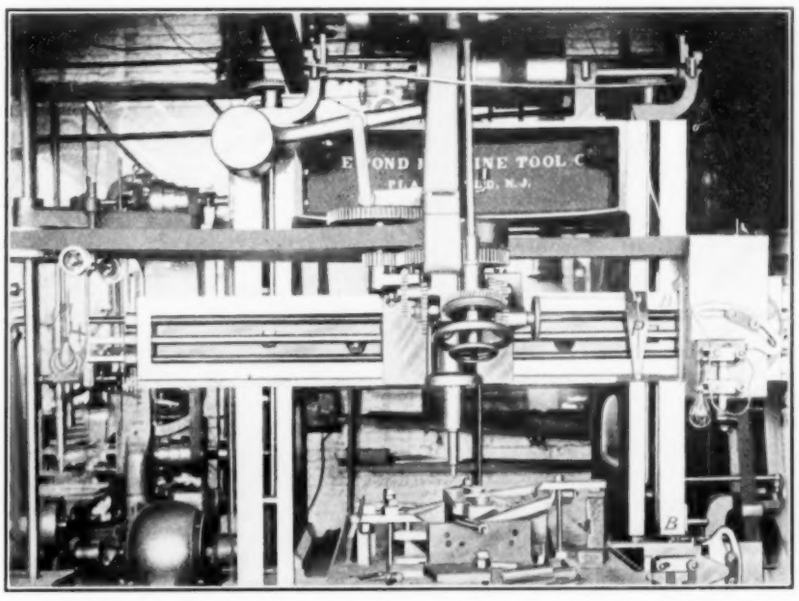


FIG. 2. PLANER WITH BORING SPINDLE MOUNTED ON CROSSRAIL.

The Hunt Company produce a large output of winding and hoisting steam engines of moderate size and electric locomotives up to about 20 tons, mostly to run on a narrow-gage track supplied by this company. This work had been built by special tools and jigs of ordinary design, which produced parts not so completely interchangeable as was desired, and new methods were devised with a view to a closer approach to accuracy in dimensions than can be expected from the use of jigs and gages of ordinary construction.

inches square through the uprights had a 4-inch diameter vertical boring spindle added, with 19 inches up-and-down movement, strongly driven by a wide range of speeds, mounted on an independent saddle to travel on the considerably extended crossrail, which carries one tool-post sad-

dle, another saddle being mounted on the right hand upright. The boring spindle is driven by a loop in an endless leather belt, and the planer, which has a 10-foot travel, is driven by an independent electric motor, as are most of the tools in the Hunt shops. This boring spindle saddle has room on the long crossrail to be moved entirely out of the way, so that the planer is not at all hampered by this addition, and the planing tool saddle can be moved to the right on the crossrail, far enough to let the boring spindle cover any piece that will pass through the uprights.

The boring mill, which swings about 80 inches, was equipped with two new elements, a heavy slotting ram and a vertical boring spindle, and the crossrail was made long enough to permit the slotter to work on the right edge of the swing circle, the drilling spindle being placed on the left, the slotting ram in the middle, and the regular boring slide on the right. The crossrail is unusually heavy, and the slotting attachment is powerfully driven. All of the vertically moving parts are balanced, and the slotter and the drilling spindle are independently driven. The slotting and drilling attachments do not in the least interfere with the handling of the boring mill as a simple tool, and one electric motor is made to drive the whole combination, only one of the elements being worked at a time.

It was at first thought that the slotting attachment would be very useful, but as it has a traverse along the rail only, its correct location involved moving the work on the face plate when used for anything more than keyseating.

The illustrations show the additions to the boring mill so clearly, that a more detailed description is not needed, because any such combination must always be designed to suit the work to be finished in it, and so must be a special creation. Hence it is quite enough to have made plain the general scheme and methods.

In the case of the planer and the horizontal boring machine the "datum" lines may be anywhere, either crossing the work itself, or somewhere in space outside of the work.

In the case of the boring mill the "datum," line always passes through the face plate axis, or in other words, through the center of the work as it rotates on the face plate. This face plate is fitted with four independent chuck jaws, by means, of which the work is held, bolts and straps and jack-screws being employed in the usual manner to assist in holding and supporting the work.

In case of the planer and the horizontal boring mill, the tool or spindle center positioning is all done by what would be called in the shops "square" measurements, that is to say by means of steel rod length-gages, applied between an adjustable hardened screw and a 20 to 1 multiplying index, by which the tool set-

TABLE OF ORDINATES FOR PLANER.

Letter.	Hole. Style and Size.	Limits.	Gage lengthwise of planer, ¼ in. Square C.R.Steel. Mark, I. S. 26815A. Mark.	Length.	Gage crosswise of planer, ½ in. Round C.R.Steel. Mark, I. S. 26815A. Mark.	Length.
A	1¼" Drill		X-A	3" + .001 − .001	Y-A	25¼" + .001 − .001
B	1¼" Drill		X-A		Y-B	38¾" + .001 − .001
C	See Drawing		X-C	5" + .01 − .01	Y-C	43½" + .01 − .01
D	1" Tap		X-D	19¼" + .01 − .01	Y-F	
E	4⅛" Bore + .000 − .003		X-E	22⅞" + .001 − .001	Y-E	32" + .001 − .001
F	5" Bore + .000 − .003		X-F	24" + .001 − .001	Y-F	6" + .001 − .001
G	1¼" Drill		X-G	33¼" + .001 − .001	Y-G	32" + .001 − .001
H	See Drawing		X-H	41⅛" + .01 − .01	Y-C	
J	2 11/16" Bore		X-J	47 13/32"	Y-J	45 13/16"
K	4⅛" Bore + .000 − .003		X-K	48⅞" + .001 − .001	Y-G	
L	1" Tap		X-L	51½" + .01 − .01	Y-L	35¼" + .01 − .01

For 8" x 10" Engine.

Item 5 and 6.

TABLE OF ORDINATES FOR PLANER.

Letter.	Hole. Style and Size.	Limits.	Gage lengthwise of planer, ¼ in. Square C.R.Steel. Mark, I. S. 26815B. Mark.	Length.	Gage crosswise of planer, ¼ in. Round C.R.Steel. Mark, I. S. 26815B. Mark	Length.
A	1⅛" Drill		X-A	4" + .001 − .001	Y-A	26½" + .001 − .001
B	1⅛" Drill		X-A		Y-B	37½" + .001 − .001
C	See Drawing		X-C	3" + .01 − .01	Y-C	43½" + .01 − .01
D	1" Tap		X-D	17¼" + .01 − .01	Y-F	
E	4⅛" Bore + .000 − .003		X-E	20⅞" + .001 − .001	Y-E	32" + .001 − .001
F	5" Bore + .000 − .003		X-F	22" + .001 − .001	Y-F	6" + .001 − .001
G	1⅛" Drill		X-G	25⅞" + .001 − .001	Y-G	32" + .001 − .001
H	See Drawing		X-H	39⅛" + .01 − .01	Y-C	
J	2 11/16" Bore		X-J	45 13/32"	Y-J	43¼"
K	4⅛" Bore + .000 − .003		X-K	46⅞" + .001 − .001	Y-G	
L	1" Tap		X-L	49½" + .01 − .01	Y-L	35¼" + .01 − .01

For 6" x 8" Engine.

Item 7 and 8.

TABLE 2 — GAGES FOR HOLE CENTER LOCATIONS OF FRAMES FIG. 6.

ting can be very closely located. These "ordinate" or length measure rods are applied in three directions on the planer, lengthwise of the table, crosswise of the table, and sometimes, through rarely, up and down. For all lengthwise measure-

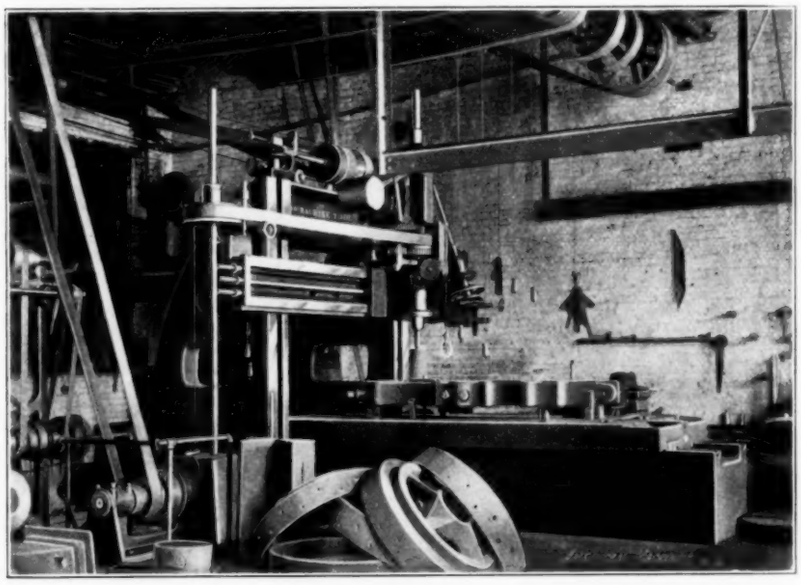


FIG. 3. LEFT SIDE OF COMBINED PLANING AND DRILLING MACHINE.

ments the rods are made of ¼-inch square tool-steel rods; for crosswise measurements the rods are of ¼-inch round tool-steel, and for vertical measurements ¼-inch octagon tool-steel is used. Some ½-inch rods were used at first, and ½-inch diameter appears in some of the "ordinate" tables, but the gages are now made of ¼-inch rods exclusively. The lengths are made as exact as may be, and the ends are hardened.

The actual forms of the measuring abutments and multiplying index fingers cannot well be shown here, as they vary according to location, but they are all alike in general scheme and conception, as shown in Fig. 1.

Two blocks are used; *A* carrying an adjustable abutment screw *C*, fixed by a pinching screw *P*, and *B* carrying the multiplying index *I*. Rod forks *F* are provided in which the measuring rod is laid. *A* and *B* are fastened, one of them to some stationary part, and the other to the moving part. The measure is laid in the supporting forks, and then the index is adjusted to match the zero mark by turning the abutment screw, which is bound by the pinching screw when the adjustment is correct. The gage rods are called in the drawings "Ordinates," "Polar ordinates," "Gages," "Implements" and "Implement sets." The abbreviation "I. S." stands for "Implement set," and means all the gage rods or tools used for setting tools to finish one certain piece, all of which bear the same implement set symbol or mark, as "26815A" in the table of "Ordinates for Planer" for 8x10-inch engine, or "26815B" for 6x8-inch engine, reproduced in Table 2. The word "gage" will be here used, as being shortest.

For use on the planer in obtaining boring spindle locations, the equivalent of *A*, Fig. 1, is fastened in the dog-slot in the right-hand edge of the table, and *B*, Fig. 1, is fastened on top of the horizontal planer tool slide, in the lower right-hand corner of Fig. 2. In these positions *A* and *B*, Fig. 1, can evidently be used to adjust the planer table lengthwise to the gage rods. Equivalents of *A* and *B*, Fig. 1, are also applied, as shown in Fig. 2 (*A* not visible), to the drill spindle saddle, and *B*, carrying the down-hanging index *I'*, is fastened at the right to the planer crossrail, Fig. 1, so as to give gage rod locations of the drill spindle crosswise of the planer.

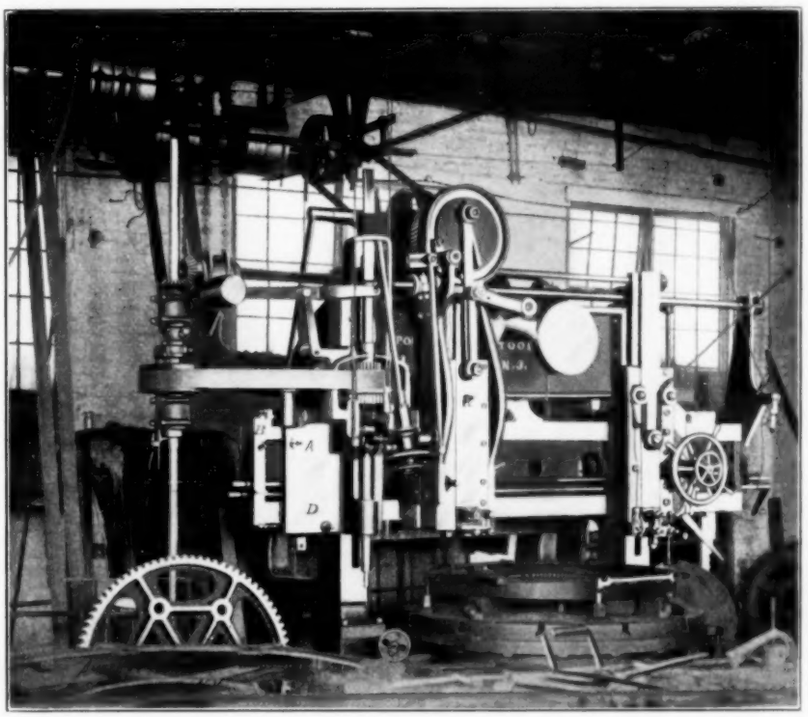


FIG. 4. BORING MILL WITH INDEPENDENT SLOTTING RAM AND INDEPENDENT DRILLING SPINDLE.

Tool-setting on the planer is the simplest, and will be described first (see Fig. 6) with reference to locating the holes *A*, *B*, *C*, *D*, *E*, *F*, *G*, *H*, *J*, *K* and *L*, in "Items" 5 and 6 and "Items" 7 and 8, which are the frames for the 8x10-inch and 6x8-inch "cable drivers," respectively. It will be noted at the outset that only one detail drawing is given out for four pieces, two rights and two lefts, of different sizes, instead of the four detail drawings which would commonly be made for these four different pieces. This drawing economy is made possible by the fact that the different pieces are of the same general shape, so that the workman can infallibly distinguish, say, hole *E*, on this sheet, which is merely a picture to enable the workman to tell which hole is marked with a certain letter.

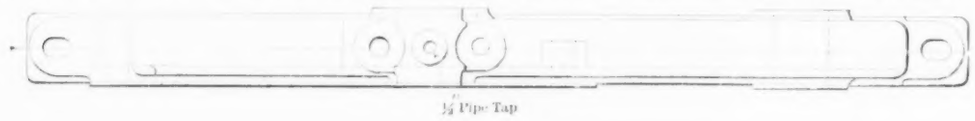
Still referring to Fig. 6, suppose the caps 9 and 10 to be fastened in place, the frame is strapped to the planer table, base to right and left end in front; hole *F* to left; the block *A*, Fig. 1, fastened to the left of the drill saddle, and the block *B*, Fig. 1, fastened to the plain crossrail, also to the left of the driller saddle. The base of the frame is left rough. The centers of *K* and *G* are in a line parallel to the base, equidistant between holes *A* and *B*; these

points locate the frame on the planer table. The frames are all planed to a uniform 5-inch thickness, which is an ordinary operation, and the first side may be planed after the frame is strapped to the planer table and before the holes are bored, or after all the holes are bored—suppose the side planed first, using the planer as a planer only.

The workman may begin by boring any of the more important holes, as *E*, setting the boring spindle near the middle of the cylinder pad so that the 4⅛-inch hole *E* will just touch the edge of the pad as the drawing shows it should do. The workman, though he may depend much on the rough casting outlines, must, of course, make such trial measurements as to be sure not to spoil the piece, same as must always be done in locating a first hole or surface.

Whatever hole may be selected for the first, is properly located and bored, then without moving the boring spindle saddle or the planer saddle or the planer table, the workman secures the equivalent of *A*, Fig. 1, to the left of the drill saddle, and the equivalent of *B*, Fig. 1, to the cross-rail, also to the left of the saddle, and adjusts the abutment screw of *A*, so that the proper gage will make the index *I*, stand at the zero line. Supposing the hole *E*, Fig. 6, to have been first bored, then by the table of ordinates (Table 2), 8x10-inch engine, the gage *Y-E*, 32 inches long, will be used to make the index *I*, at the left of the saddle, stand at zero.

Next, without having moved the planer table, the workman secures an equivalent of *A*, Fig. 1, in the table dog-slot, so as to make the index of an equivalent of block *B*, Fig. 1, secured to the planer tool box at *B*, lower right corner of illustration, stand at zero, using, as directed by Table 2, the gage marked *X-E*, specified as 22⅞ inches long, between the gage contacts. The gage contact blocks are not again disturbed until the job is done, and something new is put on the planer. For boring, say, the hole *F* (see Table 2), 8x10-inch engine, the diameter required is given as 5 inches, and the lengthwise gage is marked *X-F* (Table 2), is a square rod, and has an implement-set mark, "I. S. 26.815A" and is 24 inches long. Consequently the planer table must be moved 1⅝ inches lengthwise backward from the position for the hole *E*, first bored. For the crosswise location of *F*, a round steel gage having the individual mark "*Y-F*," and 6 inches long is specified, in Table 2, which calls for 32 — 6 = 26 inches movement of the boring spindle to the left on the crossrail. Thus the location of the hole *F* is fixed as 1⅝ inches to right in drawing, or to rear on planer table, and 26 inches above in drawing, Fig. 6, or to left on planer table, of the location of hole *E*. It takes much longer to tell this than to place the boring spindle in its hole *F* location, but if the reader obtains a clear idea of how the gages are marked and used for one hole locating, he will understand the whole scheme, so far as planer and horizontal boring machine work goes.



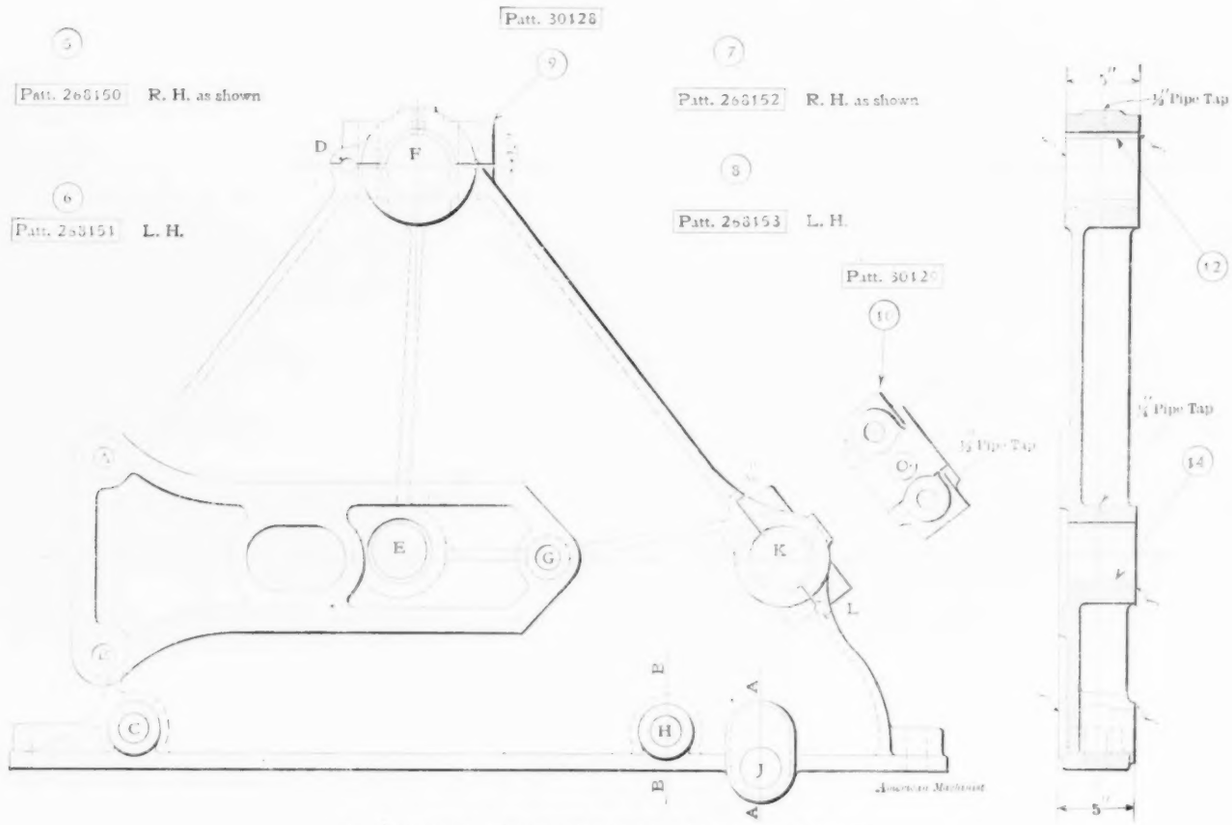


FIG. 6. DETAIL DRAWING OF RIGHT AND LEFT CABLE DRIVER.

It will be noticed that Table 2 gives at the left the hole-designating letters, next the hole diameters, then the marks and lengths of the square rod table length movement gages, and then the marks and lengths of the round rod gages that fix the boring spindle locations on the planer crossrail, and that by use of this table and the specified gages the spindle can be placed in position for any hole in the list, in the frames for the 8x10-inch cable driving engines.

Again, it will be noticed that the same drawing serves perfectly for an alto-

gether different piece by merely using the gage table for the 6x8-inch cable driver, Table 2.

Also, it is to be noted that a small rod, fitted to length only, is the cheapest, lightest and most certain dimension measuring device known; that it has no probability of injurious wear, and that it takes little storage room. Now add that two of these small, cheap, fixed-length measures suffice to correctly locate any boring cut after the first hole is made, and also the fact that holes are more correctly placed by bringing the axis of a boring spindle to the proper location, and first rough drilling the hole in the solid, or rough boring if cored, and then by finish boring, and, after the holes are bored true, sizing by reamer, than by any other method known in the machine shop.

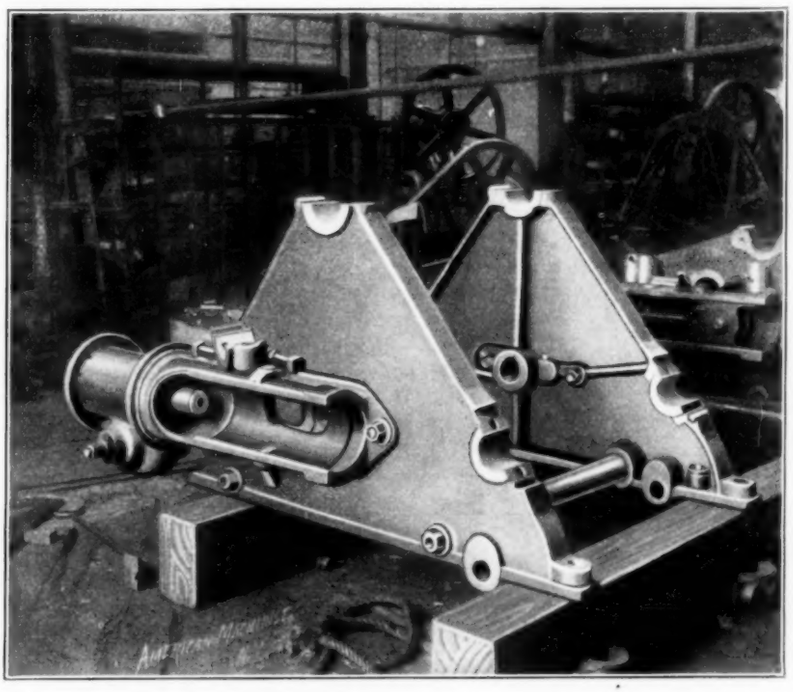


FIG. 5. CABLE DRIVER CYLINDER AND RIGHT AND LEFT FRAME MEMBERS.

This makes the grand total of advantages include the cheapest, smallest and lightest possible gages, the greatest known certainty of boring spindle location, the greatest probability that the hole made will be true with the axis of rotation of the boring spindle, and the least expectation of repairs, together with the least cost of drawings, the most varied use of drawings and the possibility of placing all the gage particulars in such tables as are shown in Table 2, which are much more easily read, and much less likely to lead to error, than the dimensions given on drawings of the common form.

Drilling jigs for guiding hole-making tools are heavy, costly, cumbersome tools for even small pieces, and are never used for work of any extended dimensions; jigs wear out rapidly, require constant repairs and, worst of all, they do not correctly locate holes.

Hunt's use of length gages as described, is applicable to work of considerable size. There seems to be no great objection to the use of gages of the sort described, as much as 10 or 12 feet long, and it seems that this method of locating cuts is vastly superior in every way to the surface table, whiting-brush and skilled layer-out of scribed lines, which are now the standard practice in hole and surface locating for all work too large to be jigged conveniently.

Echoes From the Oil Country.

GET THE RIGHT POINT OF VIEW.

I feel like reaching out and shaking hands with the correspondent that signed himself "Grad.," at page 624. I think it would be a pleasure to work alongside of him, as I believe he would be willing to exchange theoretical knowledge for practical knowledge on even terms, and not try to get "boot" in the way of adoration. I really think that he would give some information for nothing without trying to rub it in on me because I was ignorant enough to need it. If he is not filling some responsible position in the world it must be because he has already made a fortune and doesn't have to work any more.

There is only one expression in his entire article that I feel like differing with, and I believe that he uses it more in a conventional way than as expressing a fixed sentiment. The place that I refer to is where he is speaking of the errors of the schools, one of which is that they neglect to *descend* from the theoretical to the practical.

As I am trying to uphold the dignity of the "man that runs the machine," I hope "Grad." will bear with me when I suggest that the proper word to have used in that connection was *ascend*, and this for various good and sufficient reasons, if there is *any* change of level in going from one to the other.

Some reader may want to tell me that the words are merely used to designate the method of procedure, and that I am finding fault with an imaginary evil. While I am free to admit that these words are used in a variety of ways, I also know that very many people use them to literally mean going up or down, and think that they are lowering themselves when they engage in the art, and raising themselves when they leave the art for the science.

We all know something about the condition of things in our navy, where the engineering officers have been working for years to have their position put on the plane where it belongs. The British are having a like trouble in their navy, and it seems to me that at the bottom of the whole matter is the idea that a man that has become an engineer is actually lower than if he had left those things alone.

As school boys we spoke of other boys as being in lower classes, and judged them somewhat by the progress they had made for their age. To get in high classes in any study they were compelled to pass through the lower ones. If they fell down in a low class they never landed in a higher one when they landed. Boys were sometimes invited to "come down" when they were inflated with an erroneous idea of their own importance, but *that* style of being up was more of the balloon variety.

The idea which "Grad." advances, that the practical side of all knowledge is too often overlooked by instructors and students, is true. He soon found that he was only wanted for that part of what he knew that he could bring to bear on the practical side of his employer's business. We may have personal gratification out of knowledge in the abstract, but when we try to find a market for it we are apt to think that the ordinary business man cannot see anything but the dollar. Remember that he is not in business entirely for his health. If pleasure was his sole object it is barely possible that he might be found doing something else, instead of following the daily grind.

We hear a great deal about the immense help that science has been to the various industries, and science should have due credit, but what would science improve if there was no art to begin with? Take our machine shops for example: the young cub who has just learned enough to do the first rough work in the shop is of more value to the mechanical world than the man who has all the theoretical teaching of the schools only and cannot do any-

thing in the shop or for the shop. Both are advancing when they are becoming more efficient, and in neither case is that advancement a lowering process, unless the mind is in such a state that the work is considered degrading. Very often it is so considered by the man from the school, and his actions show it very plainly. The truth is that the science is an auxiliary to the art, and it is not possible for one of the roots or branches to be greater than the whole tree. What are schools, and colleges, and text books, and shops, and factories, and railroads, and combinations of manufacturers, and unions of workmen for? To know things merely? The ultimate aim of every one of them is surely to do things, and to do things that the world wants, and needs, in her business.

The time once was when it was looked on as degrading to engage in any business for the purpose of making money, and the son often despised the father who supported him in idleness, because of that father's being a successful manufacturer. Such ideas were embodied in the literature of the times and are far too common in the writings of to-day. To my mind the man who can do a thing is superior to the man that only knows how it is done, while the man that knows both is superior to both of the others.

If you think that I am over rating the importance of giving the artisan the respect that is his due, look about you and see the young men that are trying to make a living at the shabby-genteel callings. Why are they there? Simply because they have the feeling, begotten and fostered in them largely by what they have read, that these callings are more honorable and manly than the trades.

It might surprise some of you to receive some of the applications that come to a machine shop from young men that want a chance to learn the trade, and to listen to some of the talk, and see the air with which it is given. The ideas of the effort needed, and of the importance of it as compared with being a second-rate doctor, or lawyer, or preacher, or clerk in a drygoods store even, would be amusing if it were not for the fact that they show such a wrong impression of the real value of the mechanic in the progress of the world.

The real hights are up where you must assume responsibility, and where every movement works for good or for bad, and where you must keep moving, and keep others moving also; up where all the knowledge and training is pushed to its utmost to produce, not theories or high marks for slavishly following copy, but results that have a market value. No wonder that the men who occupy these positions are so busily engaged that they spend little time seeing that others give them their proper place in the literary world; but they should have it, not for their own sake, but for the importance that it is to the whole world, for without these men we would still be savages, going around clad in skins and living in huts.

W. OSBORNE.

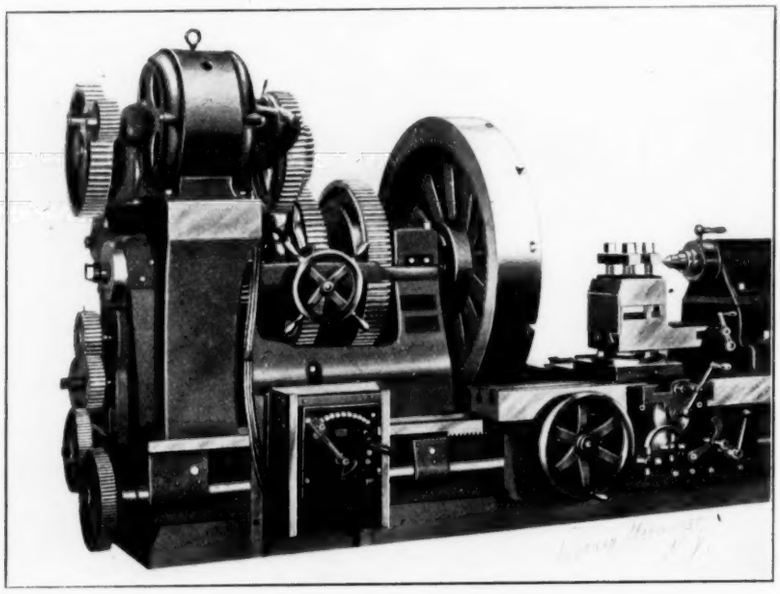


FIG. 1. FRONT VIEW OF MOTOR-DRIVEN LATHE.

Motor Drive Applied to Large Lathes.

The accompanying illustrations show the method of mounting electric motors on large lathes which has been adopted by the Pittsburg Machine Tool Company, of Allegheny, Pa. Fig. 1 shows a 54-inch and Fig. 2 a 48-inch lathe. The former is fitted with a motor in which the speed is varied by field resistance, while the latter has a Bullock motor. The arrangement is essentially the same in the two cases, and the two illustrations give, in effect, two views of it.

FIG. 2. END VIEW OF MOTOR-DRIVEN LATHE.

The construction of the headstock is essentially the same as for belt drive, but with the cone pulley replaced by a sleeve which drives the spindle directly or through the back or face-plate gears in the usual way. Upon this sleeve is a second sleeve feathered to the first, and slid endwise through the pilot wheel in front. This second sleeve carries two gears of different sizes, separated by a suitable distance, and either of which may, by the pilot wheel, be made to engage with a gear on a shaft behind the motor, from which it is driven in the manner best shown in Fig. 2. The two gears upon the sliding sleeve, the back gear and the face-plate gear give six speeds, and the gaps between these speeds are covered by the field resistance of the motor, giving a uniform and minute graduation throughout the entire range.

An obvious feature of the arrangement is that it does not involve reconstruction of the headstock, but, on the contrary, by replacing the cone pulley with the sleeves the drive may be applied to existing belt-driven lathes.

Engineering Reminiscences—XII.

[Copyright 1902.]

BY CHARLES T. PORTER.

The finest mechanical drawing I ever saw—or anyone else, I think—was shown in this exhibition. It was a drawing of the steamship "Persia," then the pride of the Cunard fleet, and was the only mechanical drawing ever admitted to the walls of the National Gallery, where it had appeared the year before. It represented side and end elevations and plan, as well as longitudinal and cross sections; was painted and shaded in water colors, and involved an almost incredible amount of work. It was made by Mr. Kirkaldy, then a draftsman in the employ of the Napiers, of Glasgow, the builders of the vessel. I am tempted to refer to this, as it forms a prominent datum point from which to measure the development of steam navigation in the brief space of forty years. The vessel did not possess a single feature, large or small, that now exists. It was of only about 3,000 tons burden. It was an iron ship built in the early days of the transition from wood to steel. It was propelled by paddle wheels. These were driven by a pair of side lever engines. The engines had each a single cylinder. The steam pressure carried was nominally 25 pounds above the atmosphere, but practically only from 15 to 20 pounds. Full pressure was not pretended to be maintained. They had jet condensers. All forged work was of iron. The vessel was steered by hand. The rigging, standing as well as running, was of hemp. It was full bark rigged.

There I first met Frederick E. Sickles, the inventor of the trip cut-off; that immortal man who conceived the idea of tripping the valve mechanism of a steam engine at any point in its opening movement, thus releasing the valve and permitting it to be suddenly closed. He had come over to exhibit his steam steering gear, which is now used throughout the world. It was astonishing how little attention it attracted. He had it connected and showed it in operation. While he turned the wheel precisely as the steersman did, the steam did all the work of moving the rudder and holding it in any position. Nobody seemed to take the slightest interest in it. I attributed this largely to his mistake in showing a very rough affair, the very thing which he thought would add to its effect. He had an apparatus that had been used on a coasting steamer, which was captured by the Confederates and employed by them as a blockade runner, and afterwards captured by our cruisers, taken into New York and condemned. He bought this gear out of it at auction and sent it to the exhibition just as it was. He believed that the more evidences of neglect and rough usage it showed, the greater admiration its perfect action would inspire. He learned better. Polished iron and brass and mahogany would have led people to believe that he himself thought it was worth showing properly.

The governor seemed to please everyone. In anticipation of a demand for them, I had shipped a number to London, which met a ready sale. The most appreciative persons as a class were the linen manufacturers of Belfast. One of them early took a license to sell them there. The first one I sold in London was to my friends Easton, Amos & Sons. As soon as they saw it in operation it struck them as the very thing they needed. In connection with their engineering works they carried on the manufacture of lead pipe by hydraulic pressure. The engine which drove a large section of their machine tools also drove the hydraulic pumps for this manufacture. It was a very trying service. The resistance was very heavy and came on and off the engine instantly. The action of the common governor was then not prompt enough to control it, and they had to employ in addition a man handling a disk valve with a very short motion. He had to keep his eye fixed on a column of mercury. When this rose he must open the valve, and when it dropped he must shut it. It had been found that this was a poor reliance for the instantaneous action required. They got a governor from me at once. I received a message from them the next day. The governor would not answer at all; would I come down and see about it? I happened first to meet an old man, foreman of the turners. "What is the matter?" "Matter! The governor won't work." I was rather an impulsive young man and replied, "It will work, or I'll eat it." He sharply responded, "If it does work I'll eat it, and I haven't a tooth in my head." Poor fellow; he was more rash than I. I saw at a glance that the governor went through but half its action. There was evidently some resistance in the valve, a common fly throttle. After they shut down at night I had the valve pulled out, and found that the chamber was larger than the pipe and that the wings of the valve were long and their points caught on the ends of the pipe. This was my first experience of the stupidity of London workmen. I could not then believe any men could be so stupid and thought it was a put-up job. The wings of the valve were soon shortened and rebedded in the chamber, and when started again the governor controlled the motion of the engine perfectly, to the great gratification of everybody, especially of the boys, who had heard the old man promise to eat it.

Directly after this triumph I received an order from Mr. John Penn for a governor to regulate the engine driving his marine engine works at Greenwich. This was the first and only engine I ever saw of the grasshopper class, quite common, I learned, in earlier days. The superintendent of his works afterwards told me, laughingly, that he had a large account against me for loss of time; that he had become so fascinated with the governor action that he had stood watching it sometimes for twenty minutes. He knew by the position of the governor every large tool that was running and what it was doing, if light or heavy work, and especially every time a planer was reversed.

One day a gentleman asked me if I thought the governor could regulate his engine. He was a manufacturer of the metal thread used in making gold lace. A bar of silver, 2 inches in diameter and 2 or 3 feet long, was covered with three or four thicknesses of dentists' gold leaf, and then drawn down to exceedingly fine threads, and the gold surface was never broken. I have often wondered how thick that gold covering finally was. The heavy drawing of the cold bars required a great deal of power, and when they shot out the engine would run away and the fine threads would be broken. No governor nor heavy flywheel would help the matter, and they had to do their heavy drawing in the night. My governor maintained the motion absolutely. Not only were the finest threads not broken by the sudden changes in the heavy drawing, but the occasional breakages that they had been accustomed to ceased entirely.

In this connection I cannot refrain from telling a good story on Mr. Ramsbottom and Mr. Webb, although the incident happened the next year. I received an order for a governor for the engine driving the shops of the London & North Western Railway, at Crewe. Soon after its shipment there came a line from the office there that the governor was behaving badly, and I would have to go and see about it. I found that the engine consisted of a pair of locomotive cylinders set upright on the floor and directly connected above, the cranks at right angles with each other, to

the line-shaft, a plan which I have always admired, as a capital way of avoiding belts or gearing. They were running at 120 revolutions per minute, and were connected in the middle of the shaft, which was about 400 feet long. The governor was flying up and down quite wildly. I had never seen such an action before, and was at a loss what to make of it. I saw no flywheel, but it did not seem that its absence could account for this irregularity. Indeed, with coupled engines running at this speed, and only trifling changes of load, and a governor requiring no time to act, a flywheel seemed superfluous. Pretty soon it came out that the want of flywheel could not cause the trouble, for they had two. Where were they? There was one at each end of the shaft, close to the end walls of the building, where wall boxes afforded excellent supports. Flywheels at the end of 2-inch shafts and 200 feet from the engine! I fairly shouted with laughter, told them to take off their flywheels, and came home. The flywheels were taken off, and there was no further trouble. Well, what should railway engineers, absorbed in locomotive designs and everything pertaining to railroading, be expected to know about flywheels and shaft torsion?

About midsummer I had the pleasant surprise of a visit from Mr. Allen, whose gratification at the show I had made was unbounded. We saw much of the exhibition together. Perhaps the most interesting exhibits in the machinery department, to us both, were the working models shown by the marine engine builders. There were a large number of these, generally not much over one foot in any dimension, but complete to every bolt and nut, superbly finished, and shown in motion. They had evidently been made regardless of cost. In the progress of engineering science, everything represented by these elegant toys has long since vanished. We were much impressed by a cylinder casting, 120 inches in diameter, shown by Mr. Penn, one of a pair made for a horizontal engine for a British warship, to work steam at 25 pounds pressure. Everything there shown pertaining to steam engineering, except our own engine, was about to disappear forever. How long before that also shall follow?

Soon after Mr. Allen's return, he sent me a drawing of his four opening equilibrium valve, with adjustable pressure plate. I realized the great value of this most original invention, now so well known, but its adoption required a rescheming of the valve gear, and that had to be postponed for some time.

In setting up the engine in the works of Easton, Amos & Sons, I had a curious example of English pertinacity. Old Mr. Amos said to me, "Porter, where is your pump?" "The engine has no pump." "No pump!" "No, sir; we consider a feed pump as an adjunct to the boiler, never put it on the engine, and generally employ independent feed pumps which can be adjusted to the proper speed. Besides, a feed pump could not be run satisfactorily at the speed of this engine." He heard me through, and then, with a look of utter disgust, exclaimed: "If a man should sell me a musket, and tell me it had no stock, lock or barrel, these were all extra, I should think it just about as sensible." Nothing would do but that this engine must have a pump. I had intended to cut off the projecting end of the shaft, but Mr. Amos ordered this to be left, and had an eccentric fitted on it, and set a vertical pump on the floor to be driven by this eccentric, at 225 double strokes per minute. Also the feed pipe had to be over 50 feet long, with three elbows.

Of course, as the boys say, we had a circus. A mechanic had a daily job, mornings, when the engine was not running, securing that pump on its foundation. The trembling and pounding in the feed pipe were fearful. I suggested an air chamber. They sent word to me that they had put on an air chamber, but it did no good. I went to look at it, and found a very small air chamber in the middle of the length of the pipe, where it seemed to me more likely to do harm. At my suggestion they got one of suitable size and attached it to the pump outlet, when the noise and trembling mostly disappeared, as well as the disposition of the pump to break loose. It did fairly well after that, and they made it answer, although I do not suppose it ever one-quarter filled. Mr. Amos was the consulting engineer of the Royal Agricultural Society. At this exhibition American reapers made an invasion of England. Mr. Amos set his face against them, and in reply to my question, what objection he made to them, he replied, "We prefer to get our grain into the barn, instead of strewing it over the field." And yet this man, the engineering head of this firm, was the only man in England, so far as I knew, advanced enough to take up the Wolff system of compounding, and who had bought my engine to run at 225 revolutions per minute, which it continued to do with complete satisfaction, until some years later, when these works were removed to a location on the Thames, east of London, when I lost sight of them.

Steam Turbines and Rotary Engines.

BY W. H. BOOTH.

It has become very usual to say that the steam turbine, by its peculiar action, avoids one of the worst evils of the ordinary steam engine, namely, the condensation of much of the initial steam by the cylinder rolls which have superficially approximated to the temperature of the exhaust steam. Were the metal of the steam turbine of non-conducting material such would be the case. One end of the turbine is exposed to boiler temperature steam while the other end will be exposed to the temperature of the exhaust steam. Between the ends it is usual to say that the metal must have exactly the same temperature as the steam which is passing continually by. But is this so? If one end of a bar of metal is exposed to heat the other end will commence to get hot. If very carefully and completely insulated the cold end would in time become as hot as the heated end. If unprotected, however, it never can become so hot because the bar is always losing heat by radiation and therefore cannot become equally heated throughout. The cylinder and the rotor of the steam turbine are simply like a bar of metal more heated at one end than at the other. Heat must constantly be traveling along the metal towards the colder end, and this would appear to point out that there is a tendency for both the cylinder and the rotor to fall in temperature below that of the steam passing by. By looking up the coefficient of conduction of the metal the amount of heat might be approximately calculated, which is lost by traveling along the metal and this amount would represent the heat lost by the initial steam during the same time. If, therefore, to the steam we add superheat to the necessary amount to combat the condensation, then should the steam be dry throughout.

Probably the heat lost by conduction is of some real moment. Both the casing and the rotor are full of projecting blades which are screwed into the metal and serve to carry heat to or from the steam so that the metal is initially well heated up and conduction must go on freely to the cold end which is equally well supplied with guide blades projecting into and in contact with the steam.

The steam turbine has been reversed and employed as an air compressor, it is said with efficiency. This explains why it is that the turbine is so inefficient as a non-condensing engine. Air is nearly doubly as dense as steam and when allowed to press in at the exhaust end of the turbine air acts powerfully against the blades. The usual method of regulating the turbine is by gusts of steam more or less frequent or prolonged. After a gust the turbine runs empty of steam and air rushes back into it and retards its motion. The condenser, however, and air pump not only help the steam to flow, but also keep off the air. The steam turbine is essentially a machine to be run with condensation.

There seems to be no end to the process of inventing new engines. We have all thought that the rotary engine of ordinary type was doomed to failure because of the enormous friction of the customary sliding shutter which is the almost invariable feature of the rotary engine. A novel rotary engine, however, has the shutter, but there is no rubbing friction. There is a cylinder and an internal rotating roller in which the shutter or shutters slide in and out. But the cylinder as well as the inner roller revolves, but eccentrically therewith, and in the same direction. The shutter is always pressed hard

against the cylinder by centrifugal force, and the outside of the cylinder rolls on rollers which work in a roller path which is circular.

The inner roller, or piston, which carries the shutter, appears from the description to roll round the interior of the cylinder. The shutter and the point of control of the roller are thus constantly approaching to and receding from each other, and steam acts within the crescent shaped annulus between. The shutter simply slides in and out and has a regular movement over the inner face of the cylinder.

The inner face of the cylinder runs of necessity exactly at the same velocity as the outer surface of the piston or shutter roller. It must do this for the one drives round the other. The shutter projects about an inch or more beyond the piston and must, therefore, at its extreme edge move a little faster than the surface of the cylinder on which it presses. There is thus a slow movement of the shutter over the cylinder surface, a movement which is nil where the cylinder makes contact with the piston and a maximum at the opposite point. But the relative motion is small—a fraction only of the rubbing motion of the old time shutter engine. There is also equally little rubbing movement of the ends of the piston and shutter upon the flat ends of the cylinder covers. Almost all the old movement of the old time rotary engine has been swept away, and its place taken by the rolling of the central shaft and of the trunnions of the cylinder upon rollers which in their turn run on circular races. The cylinder is carried entirely by its end covers which are continued externally as trunnions which bear and rotate upon the rollers above named.

The centers of rotation of the cylinder and the piston are not the same, but differ by half the difference of diameter. The difference of diameter measures the projecting part of the shutter and the "piston area" is the product of this projection by the length between the cylinder covers.

This is the maximum piston area. Its minimum area is nil and occurs at the line of contact. The piston displacement per revolution is the maximum area multiplied by the mean semicircumference of movement. The general scheme of the engine is as in Fig. 1, *A* being the line of contact of cylinder and piston and *D*-*d* being the maximum shutter projection, $\frac{D-d}{2}$ being the distance apart of the centers of rotation. The cylinder revolves in perfect balance, but the piston, of course, is out of perfect balance by the difference of effect of the shutter in and out.

Extra power is obtained with two shutters, and still more with three. Steam is admitted by the central hollow shaft through the body of the piston and into the steam space behind each shutter and it is exhausted in front of each shutter, back again to the central hollow shaft. In this central shaft is a perforated tube and a tube valve the perforations or ports being arranged to admit steam to the cylinder just as the shutters are passing the line of contact *A*. By sliding the inner tube in a longitudinal direction by a simple movement of a lever, the engine is caused to reverse. When first invited to see the engine run I only glanced at the drawing and pamphlet and it seemed to be simply one of the old rotary engines that every rotary man brings out. A deeper study showed me, however, the peculiar features which have wiped out the faults of the old shutter engine, and I found the actual machine was capable of running up to 760 revolutions per minute without vibration, doing 18 kilowatts of work and occupying remarkably little space. The whole engine is practically a piece of turning and boring work, and much of it can be turned up in long lengths and cut off to gage. It will be clear that the steam acts upon the shutter and has a moving abutment. If any steam tries to leak along the line

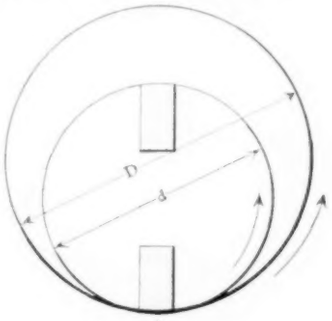


FIG. 1

FIG. 2 *American Machinist*

ACTION OF THE HULT ROTARY ENGINE.

of contact the tendency is to roll it out again. We have further what at first is a somewhat curious effect. The cylinder and the piston both rotate in the same direction by virtue of the pressure of steam contained between them. In an ordinary engine the steam presses between the piston and the cylinder cover and these two pieces move relatively in opposite directions. In this new engine the cylinder and the piston move in the same directon which is a bit disconcerting at first. Where is the abutment from which the steam takes its power to push the shutter?

If a closed vessel of V-shape be taken as in Fig. 2, and steam be raised inside it by applying heat, there will be no movement. Yet in the engine we have simply a bent "V," the end of which is rigidly attached to one leg and can move only when that leg moves. The closed "V" vessel is a favorite idea of the perpetual motion man. Now in the Hult rotary engine we appear to have something very like a closed "V" which ought to stand still. Yet as Galileo said, it moves for all that. It does move, too, for I have seen it. Yet if approached in the above questioning spirit we might begin to doubt that it would. Evidently, as it does move, there is an explanation. If the shutter stood still and we caused the cylinder and piston to revolve either way round this movement would not vary the volume of the enclosed "V" space. Obviously, therefore, there can be no effect produced by allowing these circular boundaries to move round their centers for they produce no volumetric difference by doing so. But when the shutter moves it increases the volume of the V-space and enables the steam to perform work. It is of no moment whether the cylinder and piston move or stand still. They move simply because it is convenient that they should do so.

This peculiar engine is made possible simply by introducing the steam through the central shaft. Without this detail it is not easy to see how the cylinder could be made to rotate and without the rotating cylinder the friction of a shutter engine would do for it what it always has done in all past and gone shutter engines. This engine is a practical success and bids fair to be a commercial success. It will probably find its field and also its limits of usefulness. These limits will probably be found to come in with the steam, that is to say, in connection with the limits of capacity of the hollow shaft to admit and exhaust sufficient steam for the larger sizes of engine.

The projecting shutter, moreover, must not project too far or the elimination of rubbing friction will be insufficient. But within limits the scheme is good and it has been worked out well. No attempt is made, I believe, to cause the cylinder to do work. It is simply driven round by the piston by rolling contact and makes no serious demand upon the adhesion along that line as it would do if used as a transmitter of power. The pressure exerted between the piston and the cylinder along the line of driving contact can be regulated by means of adjusting screws so that the two run together firmly without shake. All the engine is of plain cast-iron except the shaft, the rollers and their steel-lined paths on which they run. Governing is affected by movement of the inner tube valve which varies the cut-off. Mechanically the engine is a sample of what can be done by modern methods of accurate construction, but it is possible only because of the small rubbing friction, and this has been secured only by the adoption of the rotating cylinder itself possible because of the central steam admission which appears to put a limit upon the possible powers to which such an engine can be made, for it does not appear likely that the piston could be overhung on its shaft so as to admit of a sufficiently large steam pipe for large powers and if the steam pipe were so enlarged the rubbing friction of this inside the piston

would probably become excessive. Hence the limited range which this engine in common with most pieces of machinery possesses. More will probably be heard of this rotary engine. It is the only one outside the turbine class which I have yet seen that possesses practical possibilities. All others have been hopeless from the first because of their great extent of rubbing friction. That most ingenious of all, the Tower spherical engine, had this defect. The Hult engine alone avoids it in a most unexpected fashion.

London.

High Speed Metal Cutting.

BY OBERLIN SMITH.

In a recent magazine article referring to the cutting of metals upon the shaving or paring principle, I have pointed out the slowness of machine-shop processes and a consequent inherent expensiveness of all machinery, as we look back through the history of the art. It was further shown that one very important limitation had hitherto been the slow speed at which metal-working machines must necessarily run, owing to the heating and consequent destruction of the cutting tool.

It was further shown that a new era had begun, owing to the recent use of tool-steel of a somewhat different chemical composition from heretofore, which, by reason of its marvellous faculty for cutting some four or five times faster than the old kinds of steel, will inevitably tend to introduce great changes in machine-shop methods, not only in speeding up cutting operations, but in developing tools of much heavier and, in some cases, of an entirely different design.

It is doubtless a generally known fact among the readers of the AMERICAN MACHINIST that there are now in the market, both in this country and abroad, a number of brands of the new high-speed tool-steels offered for sale at a moderate price by high-class and responsible steel makers. The various kinds seem to differ somewhat in chemical composition, in methods of treating them when forging and when hardening, and in the results obtained while using, both as regards working speed and durability. They are all good, and very good, when compared with the tool-steels of ancient times—that is, of two or three years ago and earlier. Some of the brands, however, are better than others, but it is yet too early to arrive at any definite conclusion as to which is the best, especially as improvements are constantly being brought out.

Many comparative experiments have been made which are more comprehensive than the few which I have been able to conduct myself. It seems certain, however, that several good steels can now be purchased at a price between 50c. and $1 a pound, which can be worked in an ordinary forge fire, and which it is almost impossible to spoil by wrong methods of heating. These steels can be run at a cutting speed, where the machine and the work are suited thereto, varying from 50 to 150 feet per minute. It is difficult as yet to fix an average, but it probably will approximate somewhere near 100 feet. I have used a turning tool of ordinary form upon a medium-hard forged-steel shaft at a speed of over 200 feet for a minute or so at a time, but no longer. This same tool, however, ran at a rate of about 160 feet for several hours, with hardly any sharpening. These may perhaps be regarded as exceptional cases, all conditions being favorable.

We must concede, however, that even at the present stage of development all of the machinists of the world have now at command, for certain kinds of ordinary work, speeds from two to four times as great as they have been taught to use during the former years of their practice. The object of this article is not to demonstrate the above mentioned facts, but to point out some of the changes in the machine-tools themselves that the new order of things may be expected to bring about. The first and most obvious change is, of course, merely to increase the speed of the lines of shafting, driving lathes and other rotative tools, together with reciprocating tools like shapers and slotters, whose rams are not too heavy for the required speeds. Where planers of the present type are driven by such shafts there must be a considerable changing of pulleys, as (for reasons to be mentioned later on) they cannot be speeded up to any great extent.

A large velocity increase of this kind will, of course, mean much greater motive power and stronger means of transmission to the shaft therefrom. When all this is accomplished new troubles will appear. Irregular lathe work which cannot be easily balanced cannot, of course, have its speed increased, except to a limited extent, without uncomfortable vibration. Lathe work of very small diameter, if running dry, may become so heated as to prevent the desired high speed which otherwise might be attained. Belts, countershafts and lathe spindles may not behave as well, when thus spurred up to strenuous action as they have by the old-time lazy regime. It will be found, however, that on large and medium sized work of symmetrical form, especially if the cuts are of considerable length, a wonderful saving in time can be made, even with old-fashioned lathes.

So far the new steels seem to have been used mostly for ordinary single pointed tools, which can be forged and ground in the usual way. It is too early to say to what extent milling cutters, drills, reamers and taps can be made of these steels, although the work of development has begun and a number of makers of such tools are experimenting in this line. From the fact that in hardening and tempering the new tools it is necessary to burn the cutting edge almost to the melting point, there would seem to be grave difficulties in making the fine, accurate, multi-edged tools referred to above. It will, however, be interesting to see how the problem works out.

Referring again to machine tools with reciprocating cutting motions, the startling fact confronts us that nearly all the planers in the world, no matter how good, must now be put in a sort of a Pariah class by themselves and treated as Ishmael was, to be derided and suffer among their more fortunate brethren.

This is merely because they are addicted to the bad habit of moving the work instead of the tool, and are unfortunate enough to possess a comparatively heavy table which they must move with it. It is true that machines of the latch type also move the work, but these do it with a continuous motion, at a uniform speed, which makes all the difference. Furthermore, the spindle and chuck on a lathe are vastly lighter in proportion than is a planer table.

We see, therefore, that all planers of the present type are handicapped, in regard to their important and heavy members, by an irregular motion, which not only changes, and should change, its velocity at each end of the stroke, but that it is also reversed in its direction. Unfortunately, too, a gradual decrease to zero velocity at each end of the stroke, as is the case with the steam engine piston, or the table of a crank-driven planer, is not practicable with the present machines. On the contrary, the motion is brought to an almost abrupt stop, alleviated only by the natural over-run due to momentum. This, furthermore, is not uniform in amount, but depends upon variations of table load and shafting speed. It is indeed well known to be a serious defect in all belt-shifting planers. We find, therefore, that on almost all planer work it will be impossible to take advantage of the new cutting tools, as the old speeds of 10 to 25 feet a minute are as quick as is consistent with the inertia of the heavy moving parts.*

It would seem, therefore, as if one great and very radical change in machine-tool design must begin in the near future, in the way of the development of an entirely new type of planer. This must be as efficient and convenient as the present machine, but must move the tool instead of the work.

The planer problem, however, will not be the only one to occupy the talents of our best machine tool creators. It will be found that the higher rotative speeds on lathes, etc., will be much more useful with the machines made heavier and stiffer, even if we limit ourselves to the present general type. The fact has been developed that the new steels will cut heavier chips than the old ones, in addi-

* We must take issue with Mr. Smith in the matter of planers. At page 674 we pointed out that the inertia of the table is an insignificant factor in the reversal, the important factor being the inertia of the pulleys. The new Sellers planer, in which the pulleys run constantly in the same direction, reverses at about 100 feet per minute, and there is no apparent reason why it should not be driven up to the same speed for the cutting stroke.—ED.

tion to running at a higher velocity. All of our machine tools, therefore, must gradually be remodeled, to give them not only stronger and stiffer moving parts, which will convey heavier stresses, and stationary members to match, but we must put into the whole machine a great deal more cast iron than seems necessary for actual strength. Thus we will have embodied in enormous proportions the anvil idea early advocated for machine tools by Mr. Charles T. Porter and myself. A reference to old files of the AMERICAN MACHINIST will show that many years ago I compared what I termed the anvil principle and the fiddle principle, both in prose and verse—much, it is to be hoped, to the discredit of fiddle-like devices, except for strictly musical purposes. Furthermore, I most earnestly set forth the necessity of enormously increasing the diameter of lathe spindles as well as the weight of the beds and other stationary parts. Among other improvements was what then seemed the radical one of making the main journal of a 20-inch lathe spindle 5 inches in diameter against those running from 2 to 3¼ inches, which were generally used. Since then the world's practice has been gradually improved in this respect, but the 5-inch size has hardly been reached. The time has now come, however, when we must even go beyond it and throw aside the foolish idea of saving friction in a lathe spindle at the expense of its stiffness and general efficiency.

When it is considered that we run the bearings of our planers, shapers and slotters, and some boring mills, at the same speed as the tool, it is difficult to see why we should be frightened at increasing our lathe spindles to a size even beyond the average diameter of the work. The excuse for small spindles has been the high speeds necessary for very small work, but this argument applies chiefly to all-around, handy lathes, of the "Jack-of-all-trades" order, which are so excellent for jobbing shops. For modern manufacturing, however, in the strenuous lines in which it is destined to go forward, we must differentiate our machine tools much more than in the past—making large lathes for large work and small lathes for small work.

In general, the aim of the new machine tool designer must first be to lose all knowledge of the cost of cast iron and become utterly callous regarding foundry bills; then he must pile into the machine all the metal that will go in, consistently with convenience of manipulation on the part of the operator. Such convenience, however, can be attained otherwise than by making the parts usually moved by hand (as a lathe carriage, etc.) so light as to appeal to delicate muscles. More automatic motions than now can be provided, especially as these tools will mostly be equipped with direct-connected, multi-speed, reversible electric motors, and perhaps with some small auxiliary motors, in the case of heavy machine tools, for managing the various feeds and for hoisting the work.

Another object to be attained will be the grading of speeds in rotative machines with a definite percentage of increase and with a greater number of steps than is possible by the miserable cone pulleys now in use, with their large steps and their frequently bad proportioning of the speeds to each other. There must, furthermore, be convenient methods devised for quickly ascertaining the cutting speed of any tool, not only by the workmen themselves, but by that newly invented man, the speed inspector, who is, I think, destined to become an important factor in the good management of machine shops.

The above-mentioned propositions are far from complete as an analysis on the important question in hand. Some of them, however, may serve as a hint to the army of workers who are destined to solve the many problems involved in the development of the new era of machinery making, by means of the highly specialized, quick-speed, electric machine shop, with its clean floors, its light-colored and tasteful walls and ceilings, its uniform heating and ventilation, its brilliant lighting, its wire-delivered energy from beneath the floor and its entire absence of overhead machinery, except the electric cranes, which will quickly perform the conveyance from tool to tool of all but the lightest work.

The Care of Machinery—Accidents.

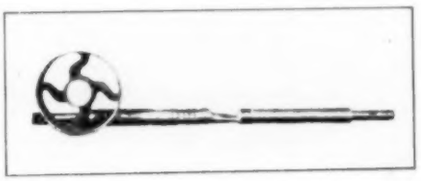
BY PETER H. BULLOCK.

Everybody knows that all things will wear out sometime, but this is another story and about things that wear out too soon or get broken before they ought to. If the three factors, material, care and conditions, were all just right, most any piece of apparatus could be classed as Lloyds do a properly constructed, equipped and manned steamship, A1 for—well, a good while. I have come to the conclusion that most any piece of apparatus will need repairs about as the above factors enter into its operation, but the human element of judgment and common sense is essential in every case.

A mortising machine was set up, and the mechanic who came with it did quick and fine work. There was a spindle for carrying a bit at one side and directly in line with the chisel, but the mechanic did not use it, as the work he did was with a ½-inch chisel and in soft wood. Not long after there was some oak to be worked that required a ⅞ mortise, and the man who had been put on to the machine did just as he had seen his tutor do—tried to force the chisel into the wood without boring any hole to start the mortise from. The repairs that were necessary might be classified under the heads of care and conditions, qualified and intensified by a lack of common sense.

A machine for forcing dies through sole leather, that had run for years without any trouble, began to break tie rods and strip teeth out of gears. After two or three *encores* I made an examination, and found that there was a lot of sole leather stock being used that was very nearly like raw hide and that would not soak soft in the usual time allowed in the tank. A few years ago I told in this paper about using common railroad scales for testing materials, so thought I would try the scheme on this leather. I put a freight car on the scales and weighed it; put a beam across the platform, but resting on blocks outside of it, then a piece of common sole leather was put on the beam and the die on it, and a jack-screw from the bottom of the car to the die. All that was necessary to do was to see how much of the weight of the car was removed by operating the jack-screw till the die was forced through the leather—2,300 pounds. Then a sample of the hard leather such as had been breaking the machine was tried, and it took 7,750 pounds to force the die through. Little wonder that gears failed under these adverse conditions and lack of judgment.

The illustration shows the countershaft



A WORN COUNTERSHAFT.

for a speed lathe, one of a lot of twenty-five. A request came to send a man to fix the shipper, as it bothered the user to ship the belt on to the tight pulley. The man brought the whole outfit to the shop, and I was willing to believe that the belt would ship *on* a little hard, but it ought to have shipped *off* easy enough to average up about right. There was no complaint about the shaft or loose pulley—they just wanted the *shipper fixed*. Why the shaft wore as shown, all on one side, I am unable to say. The cone and tight pulley had been turned inside and out, and on the new shaft were in balance; so there was no reason to suppose that the shaft always assumed one position, not at least till after it had begun to wear considerably. The shaft was 1 3-16 inches diameter, and had worn to 9-16 at the smallest point, while the hole in the loose pulley had enlarged to about 2 inches. As these combined "wears" amounted to about 1 inch and made a step of that hight for the belt to overcome, I really do not wonder that the shipper was thought to need fixing. In this case the original conditions and material, so far as I could see, were all right, but a lack of care (usually spelled oil) had produced conditions that caused the final result.

The fact that some things will inter-

change that are not intended to do so will often make trouble. There is a machine that has two projecting shaft ends just alike for carrying feed gears of 18 and 34 teeth. Each gear and each shaft end is marked with a consecutive shop number for use in ordering new ones, but there is no way, except by knowing, to show which gear goes on either shaft. Besides the machine will *work* either way, the only difference being perfect work if right, and poor if wrong. The holes should have been enough different to prevent the gears being interchanged.

I sold an upright engine that we had no further use for, and told the purchaser that it would run clockwise as he faced the wheel, 250 turns per minute, and to connect the steam pipe to the 3-inch flange and the exhaust to the 4-inch. In a few days my telephone bell was pretty busy, with the purchaser on the other end of the wire. "The engine runs the other way, and only 190; come and make it do as you said, or take it away." It seemed to be up to me to go and see what had gotten into this formerly well-behaved engine. Well, there wasn't really much the matter. Both flanges were the same size outside and were drilled alike. They had just put them on wrong, and the engine having a piston valve, it ran about as he said, and as might have been expected. The owner and piper both declared that it was connected as they received it, and I am not at all sure but they were right, for my men who took the engine down and shipped it may have put the flanges back on to the wrong sides of the steam chest themselves. If these flanges had been drilled a little different, neither my men nor the purchaser could have made a mistake.

Quite a number of years ago word came to me, while in another part of the plant, that there was trouble with the main engine. When I got there it was stopped, the gland was out on the rod and one of the studs was bent. The assistant said the nuts came off, letting the gland loose, and that the crosshead must have thrown the gland against the stud. Now, as the packing was not blown out of the box, I could not think that the engine had run very long after the nuts had come off, neither could I see how the gland could strike *one* stud and not the other one also. In fact, the whole thing seemed so fishy that I let the man go at the earliest opportunity, the unexplained absence of a box wrench that fitted the nuts on the studs having perhaps quite an influence in my decision. Very recently, in making some alterations, this wrench of ten years ago was found concealed, and its battered condition was as good circumstantial evidence of the former accident as was the finding of the fish in the can of milk thought to point suspiciously to the milkman as having accidentally put it there while adding water to the lacteal fluid he honestly thought to be too rich for his customers. The crushed box of the wrench showed the mark of the stud on one side and the curved mark of the crosshead on the other. If the man had told me he accidentally got the wrench caught, I would have overlooked it, but the studied attempt at lying out of it showed him to be unsafe.

Rule for the Length of Bevel Gear Teeth.

A correspondent writes: "In the treatise on gearing published by the Brown & Sharpe Manufacturing Company, a rule for the length of the teeth of bevel gears is given, according to which they should be five times the thickness of the tooth at the pitch circle, but in no case longer than one-third the distance from apex of the cone to the pitch circle. I know of bevel gears working successfully that have teeth longer than this. I know from experience that gears with teeth longer than this do, in some cases, give good results, and would like to have you give a rule to determine the proper length of bevel gear teeth."

We consider that the allowable length of a bevel gear tooth will depend upon circumstances, and that if the best possible results are sought in any given case, the length of the teeth must be proportioned to the circumstances of that case. Hugo Bilgram, of Philadelphia, having had a very wide experience in the manufacture and use of bevel gears, and having made such gears a study, we referred this question to him, and in reply to it he writes as follows:

"I think a general rule can hardly be given, as each individual case may involve different conditions which require specific treatment. On the whole I think the rule given by Brown & Sharpe to be very good. I would not advocate longer teeth, for the following reasons:

"As teeth are lengthened towards the apex they get smaller, so that the increase in strength, if any, is not commensurate with the extra care required in setting the wheels. The longer the teeth the more accurate must be the workmanship to avoid transferring the thrust to one corner of the teeth. As we never can make mathematically correct work, a bearing along the whole length of the teeth is very difficult to obtain in bevel wheels, much more so than in spur wheels, because it is more difficult to avoid both the teeth of the wheels and the bearings of the shafts running askew than it is to cut those of spur wheels parallel with the shaft. And if the bearing of the working sides of bevel wheels should happen to be on the small ends of the teeth, a lengthening of the face will actually increase the danger of breaking off a corner.

"When the object is to reduce the danger of backlash from wear and care is taken to get a bearing along the entire tooth, a greater length may be advocated."

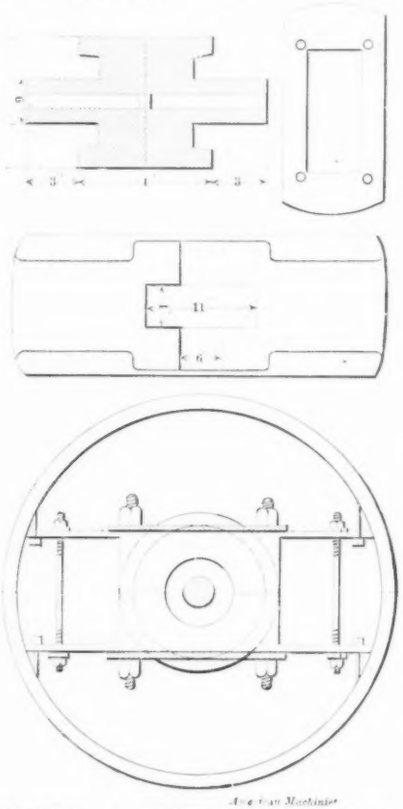
Letters From Practical Men.

Clamping a Pulley Over a Flange Coupling.

Editor American Machinist:

A coupling or a hanger often comes on a shafting line at a point where a pulley is required. A hanger can generally be shifted, but to shift a coupling by changing or moving the shafting lengths into different positions is usually too expensive for consideration.

Here is how a 10-inch face, 24-inch diameter wood split pulley was put on a flange coupling of a main shaft to drive, by means of an 8-inch double belt, an extra large drop hammer.



CLAMPING A PULLEY OVER A FLANGE COUPLING.

The pulley was first rebored to 6 inches scant, so as to make a good clamping fit on the hubs of the coupling. To allow the pulley to go on at the 11 inch diameter 4 inch wide flanged portion of the coupling, it was partly bored and partly chiseled out, as shown by the dotted lines. Two plates 3-16 inch thick, of wrought iron, were used to strengthen the pulley where cut away and to reinforce its clamping grip.

GEORGE FRANK.

Repairing a Crank Pin.

Editor American Machinist:

Passing through the engine-room of our factory one day recently, I found the engine pounding badly, and on having the engineer shut down, discovered that the crank pin was very loose in the disk.

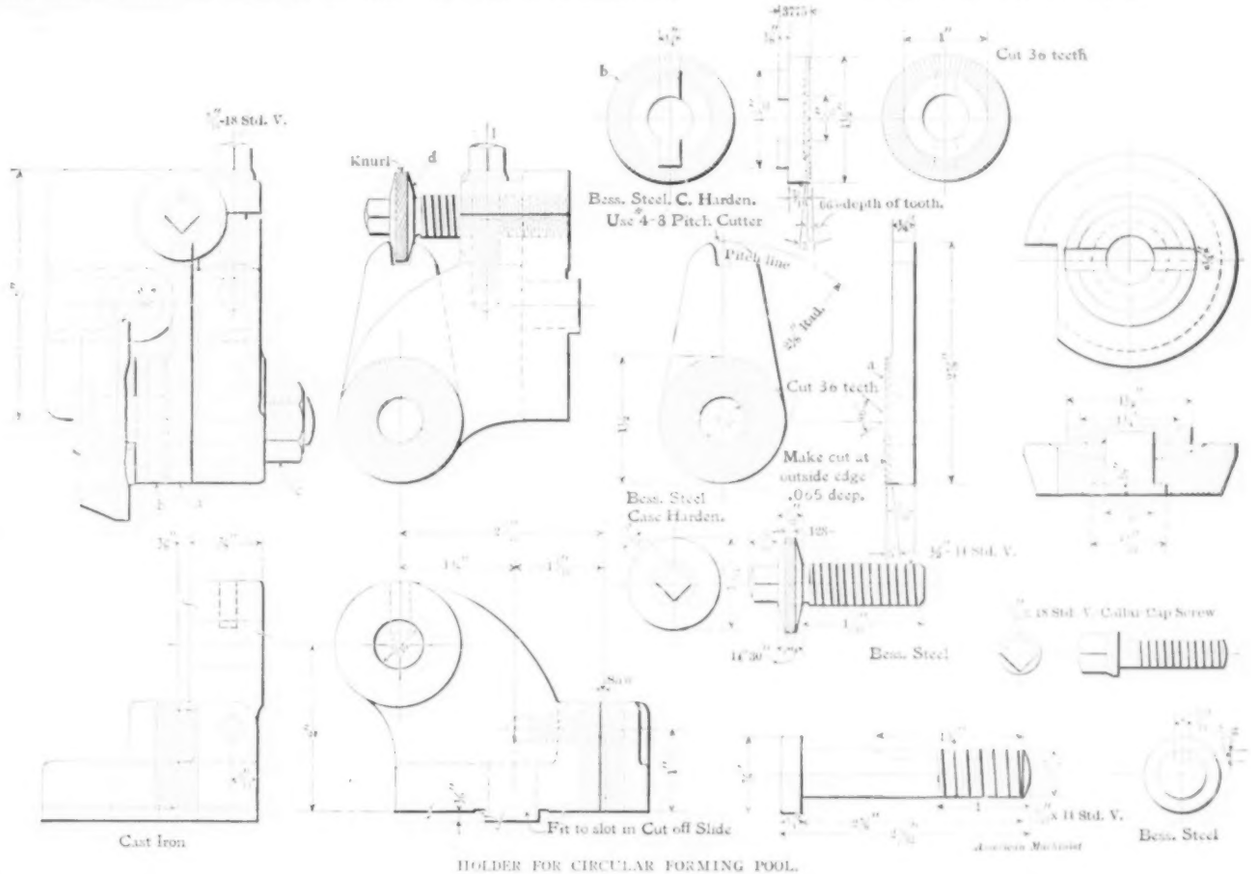
As we were too busy to shut down for

any length of time, I decided to make a quick repair job. We first chipped the head off the pin where it had been riveted into the disk, and drove the pin out, then drilled a hole in the end of the pin and tapped it out with a ½-inch pipe tap. Next we turned up and threaded a tool-steel plug to the same taper as the tap, but large enough so that it would enter only two or three threads. We then cut four slots in the pin nearly to the shoulder, and drove the pin into the disk. The final act was screwing the plug in very tightly, thus expanding the pin in the disk until it was tight. As there was no room between the disk and the bed of the engine, we broke the plug off with a hammer. The results were entirely satisfactory. M. E. W.

Circular Forming Tool-Holder for the Automatic.

Editor American Machinist:

The drawings show a circular forming tool-holder which was made for an automatic screw machine and which has proved perfectly satisfactory.



HOLDER FOR CIRCULAR FORMING POOL.

The object of the device with which this holder is fitted is to give an adjustment to the forming tool after grinding, and also to avoid milling radial grooves in the tool to match those shown in the adjusting arm *a*. As is understood, it is customary to grind these tools a certain distance above the center, and after regrinding it becomes necessary to adjust the cutting edge to its former position.

This operation is performed with this holder as follows: Release the collar screw *e* and nut *c*, then adjust the knurled thumb-screw *d*, which adjusts through gear segment *a* and washer *b*, the circular cutter When the cutting edge is adjusted to its proper position, tighten collar screw *e* and nut *c*, and the machine is again ready for work. The radial teeth in the washer *b* and the arm *a* make it possible to use up the full circumference of the tool and also obviate the expensive operation of milling teeth in every one, as one washer *b* will wear out dozens of tools.

Wilkinsburg, Pa. O. P. HIPPLE.

Inspection of Work.

Editor American Machinist:

I suppose there are readers of the AMERICAN MACHINIST that are having trouble with detail inspection and, like myself, are pleased to note that we may have a little space for articles dealing with this side of manufacturing.

There is no doubt but that the views of some of the readers on this subject would be welcomed by many who are in doubt in regard to the limits to which detail inspection should be carried.

There appears to me to be an apathy existing in the majority of shops in regard to this subject, and a sort of a "sorry-I-have-to-do-it" air seems to prevail when inspection is mentioned. Of course in some of them there is a pretense made at it. That is, there will possibly be a few boys 'gaging screws or testing some of the finished parts, making it really a sorting process rather than an intelligent inspection. Now while I consider it necessary to gage the parts, I don't think it amounts to much unless it is a part of a more complete system, for all the gaging that can be done on a part after it is finished will never correct an error, and seldom prevent a repetition of it.

In many shops the department foremen are expected to see that the parts are properly made, but if they have a department of any size, they are kept pretty busy, and have not enough time left from their other duties to give the parts the inspection they should receive. Furthermore, they are in a great many cases not sufficiently familiar with the functions of the piece in the assembled machine to pass upon it intelligently. Consequently, the degree of accuracy is often left to the men, and the result is that the fellow that does the sorting is always sure of his job.

If we must give inspection a place in the shop, to make it effective we should give it the same attention that we do the other departments, and make it possible for the inspectors to prevent the production of parts that are not up to the required standard. To do this we should have each operation passed on by a competent inspector at the time the operation is started, and not wait until the job is finished before we set out to find if the part has been made within the required

limits. If we follow this plan then we have a chance of making this branch of the shop pay its own way by reducing the amount of spoiled work and removing the many troublesome things that the assemblers have to contend with.

The greatest trouble is in getting a big enough man for a chief inspector; a man that has the tact and experience necessary to make a good one is also capable of doing other things, and with an equal salary usually prefers to do them rather than shoulder the burdens of this department.

The remedy is simple enough if you will recognize the importance of the position, make it more desirable in the way of salary, then get a good man and make him responsible for the accuracy of the parts. This plan tones up the work, eliminates the friction between the departments and relieves the superintendent of his duties as a peacemaker. H. HUGH.

Numbering and Filing Drawings.

Editor American Machinist:

I never expected to write to you about my "system" of indexing drawings, for I m not particularly proud of it and fully realize it is a long way from perfection. In fact, I have never before considered it as a "system," but after reading some of the recent articles on indexing I concluded mine was not the worst old way, after all. While it certainly has faults, it avoids some of those mentioned by others, and it has the three good qualities, simplicity, compactness and low cost. Perhaps I should say before going further that I seldom use tracing cloth, but I have two or three drawers of tracings, and they keep in good shape by the plan described later.

Years ago I found a drawing paper whose surface is about all one can ask and which is yet so transparent that it yields a first class print in a reasonable time. I make my pencil drawings on this, tracing from others if I wish, ink it carefully and it is done. These drawings are all kept rolled when larger than 9x12. Each roll is a complete set for one machine, and each class of machines has a drawer to itself, or a part of a drawer. On each roll is a tag giving the drawer number and the letters and numbers, which indicate the contents. Sample tags are shown in Fig. 1. and sheets form my index book in Figs. 2 and 3.

This book is of the loose leaf type, and therefore capable of unlimited expansion, even to several volumes. It has two sets of index tabs, one for work indexed under the initial letter of the machine and one for mill plans, flumes, stone sheds, etc., which are indexed under the customers' names. Each page has five columns, the first giving the name of the machine, second the initial letter, third the serial number, fourth the drawer number and fifth the number of sheets in the set.

While I prefer a certain group of serial numbers for each class of machines, Mr. Worcester's plan of consecutive numbering could be used just as well. If I exceed the allotted space, as C-250 to C-275, I can make a second series of C-0250 to C-0275, and this gives a clue to the class of machine which consecutive numbering does not and which is of great help to me, as I am obliged to keep a large stock of blueprints on hand, and I index them merely by the letter and number. They are kept in pigeonholes, as are also the 9x12 drawings. These are in heavy manila envelopes, each machine by itself and each class in a separate pigeonhole. These pigeonholes are numbered like the drawers, and it is short work to locate a drawing.

Tracings are all of one size (24x30), and are kept flat between paper boards having marginal tabs, which serve the same purpose as the tags on the rolls. I should perhaps mention that the 9x12 manila envelopes are similarly marked with a list of their contents. All three methods of storing are compact and keep the drawings clean, and each can be found with but little handling of its neighbor.

The keystone of my system is, of course the loose leaf index book, which costs as much as three or four of the common kind and is worth a dozen. It is a very fair substitute for the card system, which is probably the best yet devised. If a sheet or set of drawings is discontinued, if a mistake is made or a leaf gets damaged, only that one need be rewritten or replaced. Unlimited expansion can be accommodated and the transfer be the work of but a few minutes. During the seventeen years I have been in charge of these drawings I have written three index books, the first two being outgrown and

Clapboard Machinery

Clapboard Sawing Mch.	*C –*	*250*	*16*	*8*
Clapboard Log Lathe	*C*	*251*	*16*	*3*
Clapboard Planer	*C*	*252*	*21*	*9*
Clapboard Clipper	*C*	*253*	*20*	*3*
C. E. Grandy's Special Sapper Attachment	*C*	*256*	*16*	*1*
Setting Device	*C*	*258*	*21*	*2*

American Machinist

FIG 2. PAGE OF INDEX BOOK.

C – 250 *Drawer No. 16*

Clapboard Sawing Machine

8 sheets

M – 1380 *Drawer No. 8*

Mill Plans for

Peck Lumber Co.

2 sheets

American Machinist

FIG. 1. INDEX TAGS FOR DRAWINGS.

having no means of adding to them. I believe this one will last as long as I shall.

E. R. PLAISTED.

Modern Machine Repairs.

Editor American Machinist:

I have often remarked, and everybody, as far as I know, has always agreed with me, that the small, local jobbing shop must always be an institution everywhere and must always be sure of lots of work in the mere repairing of the variety and volume of machinery now in use. I am getting to be not so sure of this as I was. One of the things which I can't help noticing in connection with the operation and maintenance of manufacturing, or constantly employed, machinery is that while in, say, the last twenty-five years the employment of machinery has been vastly extended and the number of different machines or types of machines has enormously increased, the trade of the local jobbing or repairing shop has not advanced in the same ratio, if, indeed, it can be said to have grown at all. I don't believe it has.

When we come to think of it, there are various things that may be made to contribute toward an explanation. Machines as employed for manufacturing, being now built in shops in which they are a specialty, are built better than they would have been under the old single-machine, cut-and-try system of construction, and they are therefore less likely to break down or give out in any way, and they do in fact suffer derangement less frequently.

It may be worth questioning whether the machines are not more carefully, skilfully and intelligently, and therefore more safely, operated. I know how the professional educators are worried about the decadence of skill, and I am not saying that they are not mostly correct, but the arrangements of the manufacturer enable him to get along better than formerly, even with the conceded narrower range of skill in the individual. The man who operates one machine constantly, and that upon a very limited range of work, can soon be trained to great reliability and efficiency, if the desirable attitude of the man's will can be secured. The wanting to do is the one essential thing that cannot be dispensed with in the efficient and reliable workman. The wanting to do includes the desire and determination to keep on doing, and this is a great preservative of the machine.

Mill Plans

Parker & Young	*M* –	*1375*	*8*	*2*
L. S. Paddock		*1376*	*8*	*2*
R. Palmer & Son		*1377*	*8*	*3*
Prouty & Miller		*1378*	*8*	*1*
Pike Mfg. Co.		*1379*	*8*	*4*
Peck Lumber Co.		*1380*	*8*	*2*
Stone Sheds				
Producer's Granite Co.	*S* –	*1375*	*9*	*3*
N. C. Parker	*S*	*1376*	*9*	*4*

FIG. 3. PAGE OF INDEX BOOK.

Now as to the perfection and reliability of the machine, and its little liability to get out of order as it comes from the builder, it may be remarked that in the building of the machine he has been practically compelled to concentrate his energies upon producing something good and reliable, in order to hold his market. He has kept in touch with his customers, has kept his eye on the machines that have gone out, and has learned of the troubles that have most frequently beset them, and these he has mostly eliminated. He has found what material, or grade of material, is best for each part, and that he has adopted and systematically provides. He has made special jigs and fixtures, and often has built special machines, for producing the details cheaply and yet with precision and close duplication. He has records, drawings, gages, etc., that enable him to replace broken, worn or deranged parts much more quickly and cheaply than they can be made by an outsider.

The builders of machines formerly found great profit in the repairs that were required for them after they were sent out and put in regular operation. I went once as foreman to a shop which had built a great many "jack-heads" for textile mills, but the building of them had been discontinued because at the price at which it was compulsory to sell them money had been lost on every one that was built. When I was there, however, the boss was rapidly getting back the money lost, and much more, too, in supplying the numerous repair parts that were called for for years after. The old trick of using special screw threads or special sizes or shapes of parts, in order to secure the profit from the repairs of machines, has been rendered an unnecessary and useless device, and it is now generally abandoned. The entire system of machine building now works for the manufacturer as the supplyer of repairs, and unless his charges are outrageous he should be practically sure of the trade, and a convenient supply of parts as required, with a gang of expert repair men, renders any establishment tolerably independent of the local repair shop.

The small repair shop man not only must find great difficulty in competing with the machine builder in supplying repair parts, but he often must find it difficult and sometimes, with his best efforts, impossible to supply parts in every way as satisfactory as those of the builder. Builders therefore cannot be expected to have much affection for the local repairers of their machines, and this may operate to some extent to keep the prices of repair parts down to a reasonable scale. Sometimes it becomes necessary for machine builders and the makers of mechanical specialties to protest against the local repairers as damaging to their reputation. Thus the manufacturers of a patent car coupler have quite recently sent out a complaint and warning against the way in which their specialty has been repaired. They say in their letter: "It has been brought to our attention recently that some railroad companies are replacing, when broken, the drop-forged steel operating rods of our couplers with cast-iron, malleable-iron or cast-steel imitations of these rods. The impropriety of such replacements will be conspicuously apparent to the operating departments, particularly since these imitations do not even conform in essential dimensions, etc." This would seem to an outsider to be a specially bad case, as of course it should be the duty of all who have to do with it to make a car coupler as reliable as possible.

The highest recommendation for any machine or operated device would seem to be that it requires few and infrequent repairs, but it is essential that when re-

pairs are required they shall be made as quickly and cheaply as possible, and that when the repairing is completed the thing repaired should be "as good as new," if in the nature of things this is possible. It should generally be in the hands of the builder to control the repairs of his machines if his first aim is to secure their general efficiency. We can easily understand how a builder should first of all desire to make the building of his machines profitable and the sale of them constant, and he therefore must make them to require few repairs and to make the necessary repairs cheap and easy. The local repairer, whose profit must all reside in the repairing, can never be expected to do anything towards the reduction of his employment. The reduction of such employment seems, however, to go on in spite of him. TECUMSEH SWIFT.

Centers for Appearance' Sake.

Editor American Machinist:

Reading C. H. Norton's article on "Center Punches," etc., at page 346, reminded me of an amusing incident that happened in Nagasaki, Japan, a year or so ago. The chief engineer of the ship on which I was serving had some work, consisting of pistons and rods for the steam launch engine, done by a small Japanese shop, and it was particularly specified that the "centers" should be drilled and left in all the turned work, for truing up the parts when worn. Now, the Japanese are the greatest imitators in the world, and most of their methods of machine work have been acquired from English examples. It was only natural, then, that the parts were brought aboard with the centers carefully cut out, or rather cut off; but the Jap was so anxious not to have the work rejected that he took the pieces out unto his "sampan" alongside, and with a fire brick and something that looked like a wire nail he put marks in the ends of the rods, bringing them aboard again, saying that they were *tihen urashee* (very much all right). The best part of it, for the Jap, was that the work was accepted. C. W. D.

An Indexing Jig for Drilling and Reaming Couplings.

Editor American Machinist:

A short time ago in a shop where a great many shafting couplings are turned out, the thought struck me that it would be of great advantage to have a jig for drilling and reaming these couplings without making a separate jig for each size. I therefore designed a jig, as shown in Fig. 1, which does the work more accurately than when we did them clamped together, and reduces the time of drilling over one half.

As is shown in this photograph, the coupling is jigged from the bore and not from the outside, which is often not true with the bore on account of being turned on a poor mandrel or in a poor turret lathe. This jig is used to drill and ream six different sizes of couplings, the bolt hole circles, in five sizes, being of different diameters. There are six holes in each coupling, and index plate *I*, Fig. 2, is provided with six notches. Two hardened and ground steel bushings are all that are required for each size of hole, one for the drill and one for the reamer. These bushings are nicely fitted and removed almost with the fingers alone. It is necessary to change the bushing after drilling the coupling and place the bushing for reaming in

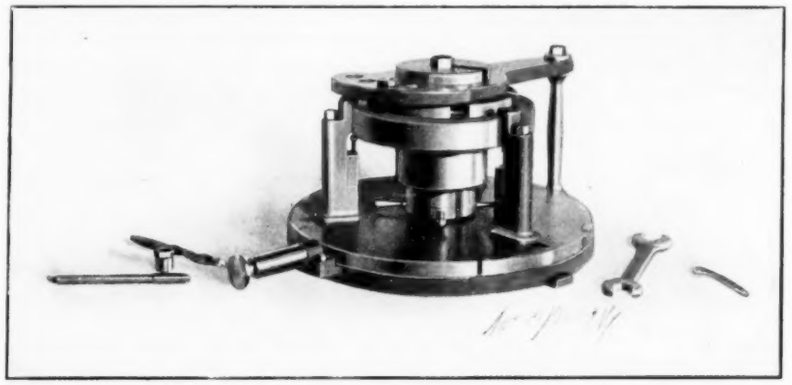


FIG. 1. INDEXING JIG FOR DRILLING AND REAMING COUPLINGS.

the jig. The bushings are squared on top, and with a slight twist with a wrench will slip out. Bushing *A* is first placed in the taper hole in the coupling and then placed over stud *B*, which is fastened to index plate *I*. Sliding blocks *C*, *D* and *E* are pushed up to the coupling and tightened down, and wheel *F* is turned around until the coupling is tight against the projections at the top of the blocks; ½-inch screws in *C*, *D* and *E* are screwed tightly against the coupling, and collar *G* is then placed

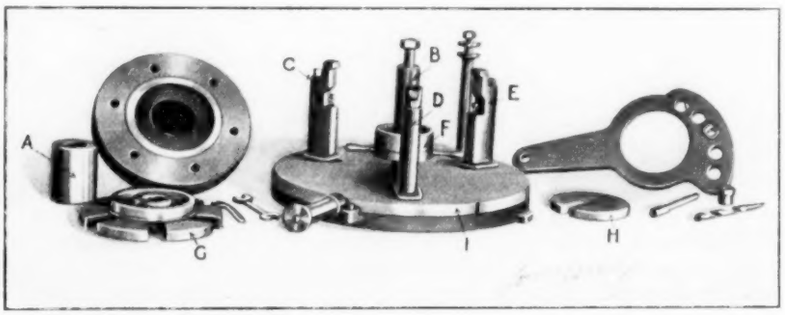


FIG. 2. JIG DETAILS.

over the stud. The bushing plate is placed over this collar, and collar *H* is then tightened down on *G*, bushing plate remaining stationary while the coupling is turned around, stopping at each notch in the index plate.

This jig can be used for different jobs with the best results, as a great deal of time is saved by not having to move the work or square up under the drill after each hole is drilled. JOHN GALLAGHER.

Watertown, N. Y.

An Able Automobile Salesman.

Editor American Machinist:

I came across an automobile salesman the other day, who was a crack-a-jack, and he was extolling the merits of his carriage to a prospective customer in an able manner. The points of superiority were, most of them, new to your readers, and I think they will enjoy hearing about them.

"In the first place, our condenser is away beyond any other in the market. The first one was tried by one of our best operators and while he was out a heavy fog came up, and he started to run back to the shop, when he noticed his water tank was brim full and running over. An investigation showed the condenser had been condensing the fog and sending it into the tank.

"Then, we have a strainer on the feed water valve that not only collects all dirt, but it puts it into shape so it can be disposed of. We sold a rig to a lumber dealer up in Maine, and what do you think? There was so much sawdust in the water that the second time he blew off his boiler, out came most of a bundle of laths; the valve had compressed the sawdust in the water into that shape. Then our boiler is arranged with a valve between the engine and boiler that increases the pressure to any desired amount, without any extra pressure, on the boiler. This is a new discovery and is only applied to our higher priced carriages. Our new boiler is also equipped with a dividing line, so that if you should happen to burn

out a boiler on one side of the line, you still have the other side to come home on. This is a very valuable idea."

These are not all of the new points the salesman had, but they were all I could stand at one time, so I left him. I don't know as he sold the car; but he ought to, if good talking would do it, as I overheard a well-known business man say of him, "He is the smoothest tongued liar I ever saw, and it is a pleasure to listen to him, even if he does lie."

A. P. PRESS.

A Lathe Reamer for Reaming Straight Holes.

Editor American Machinist:

The problem of reaming a straight hole in an engine lathe that will not bore a straight hole is solved, and the solution is shown in the accompanying sketches.

During my experience in machine shops I have seen but a very few lathes that were constantly kept in good enough repair to enable them to bore or ream a straight hole; it being necessary to take the work out of the lathe and run a hand reamer through the hole in order to make it straight and smooth. I have used reamers that were loose on the shank and driven by pin through both, but they would cramp after reaming a short distance. This is on account of the pin being so far from the cutting edges, which leads to cramping and to rough taper holes.

I have given this reamer a severe test in an engine lathe by setting the tail-block over off center 1-16 inch, oiling the hole and putting a little oil on the reamer and leaving 1-16 inch to ream, the hole being 2 15-16 inches diameter and 12 inches long. It made a smooth and absolutely straight hole.

It is not necessary to hold the reamer back by dragging carriage after it. It will not draw in, as is often the case with fluted reamers if not held back to the center of the tail spindle.

Fig. 1 shows the reamer shank *A* with a ½-inch pin *B* driven in the end to a shoulder; ⅛ inch from shoulder is a small fillet, which is required to take the pressure of the cap *C* when reaming. Cap *C* has no fillet, and it may thus swivel all that is required on pin *B*. Three ¼-inch tool-steel pins are driven in shank *A*, as shown in the end view, and are flatted to fit ¼-inch pins driven in cap *C*, Fig. 2. Cap *C* is threaded left-hand and screwed in shell *D*, Fig. 2. The whole arrangement is shown assembled in Fig. 3. Driving the reamer so near the cutting edges with three points for bearings and with the shell 1-32 inch loose on the shank must necessarily make a straight hole. Pin *E* is for keeping the reamer from coming off the shank when removing from work.

JOHN GALLAGHER.

[We can see no reason why fluted shell reamers should not be driven in the same way and with obvious advantages over the usual method.—Ed.]

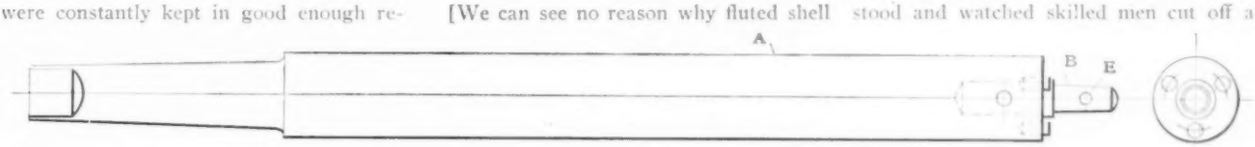


FIG. 1

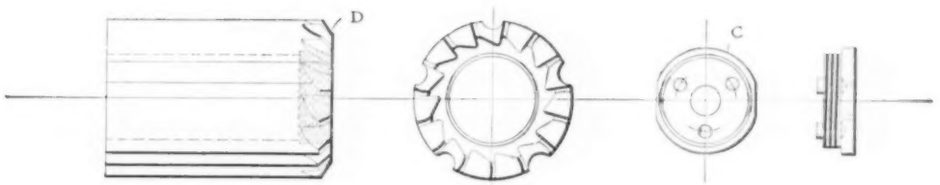


FIG. 2

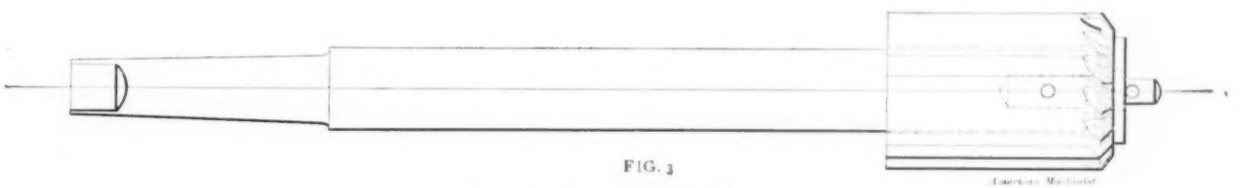


FIG. 3

A REAMER FOR STRAIGHT HOLES.

Patternmaking in the Foundry.

Editor American Machinist:

Patternmaking in the foundry, as suggested by Mr. Tecumseh Swift in his letter on "Carving Sand" at page 413, seldom pays. Very frequently skeleton patterns are made to save a little timber and patternmakers' time, necessitating a heap of trouble on the molders' part, with more risk of failure, and in the end very possibly a crooked or ill-shaped casting. All who have had experience in putting into use the results of such attempts at pattern saving know that time is frequently wasted in the machine shop in the extra tooling and finishing of these castings. To save making a core-box we have sometimes allowed a core to be rubbed from a block of core sand, perhaps a chamber core, and the result has been that the required clearance has had to be made by boring with a long, slender tool.

Another difficulty encountered is that few molders can understand a sketch, and hence the patternmaker must spend as much time as would be occupied in making a core-box in explaining how the job is to be done, and then what if a waster should be made, which is more than probable in a makeshift job?

Sand artist indeed! Trust the ordinary molder to even mend up decently a broken mold and you trust in a broken reed. Perhaps this is not because he can't, but that he objects to spending time on what he considers unimportant trifles, which don't go to swell the weight. And sand is, after all, very tender stuff; while mending up one part the other end of the cleaner or a too long coat-sleeve is bound to bring down more sand. I have often stood and watched skilled men cut off a corner to form a fillet in the casting, and when done the radius has varied from infinity to very nearly zero. Of course this was by reason of the absence of proper radius smoothers. Seeing, then, that it is so difficult to even do elementary and necessary carving in sand, where are the men to be found who can cope with the difficult work of originality in sand articles of artistic or complex character, which is Mr. Swift's idea, I presume? And, even if such could be found, then the saving would be even more doubtful than in simpler cases. Just think for a moment; how much longer would it take for a patternmaker or a woodcarver to carve out an ornament in wood than for the molder to do it in sand? Not much, I guess, and in the event of a waste being made from a wood pattern little time would be lost in trying again.

The case of the broken connecting rod is one example of doubtful saving, for

three pieces of wood would have made an excellent pattern at little cost in time and would have saved a heap of molding, and could have been prepared during the hunting out of tackle time.

However, there are ways of saving patternmaking, and one of these is to make patterns in core sand. But here, again, it is more of a patternmaker's or machinist's job to do this than a molder's. You take the block of dried sand and roughly hew it to shape with an old hack-saw blade and then trim it up with a file, smooth off with sand-paper and give it a coat of pitch to stiffen it and produce a non-sticking surface. This will stand a good bit of rapping and will serve for several castings. To reduce the sand to shape the emery-grinder is far better than a file, and it is surprising how nicely the sand is removed by grinding. By the help of a pair of calipers, straight-edge and square, I have personally made very decent patterns out of dry core sand.

The emery-grinding trick is worth noting, too, in connection with rubbing cores. On a circular core held in the rest and rotated before the wheel the ends may be neatly tapered to fit the prints, a corner rounded off in similar manner, and so on.

No, after due consideration, I see little to be gained in training molders to become "sand artists." Let us rather bring up "sand sculptors" and "sand modelers," for here we can save. Let us instance the pipes that are made by making sand patterns and we have at least one case where the "sand modeller" shines.

England. FRANCIS W. SHAW.

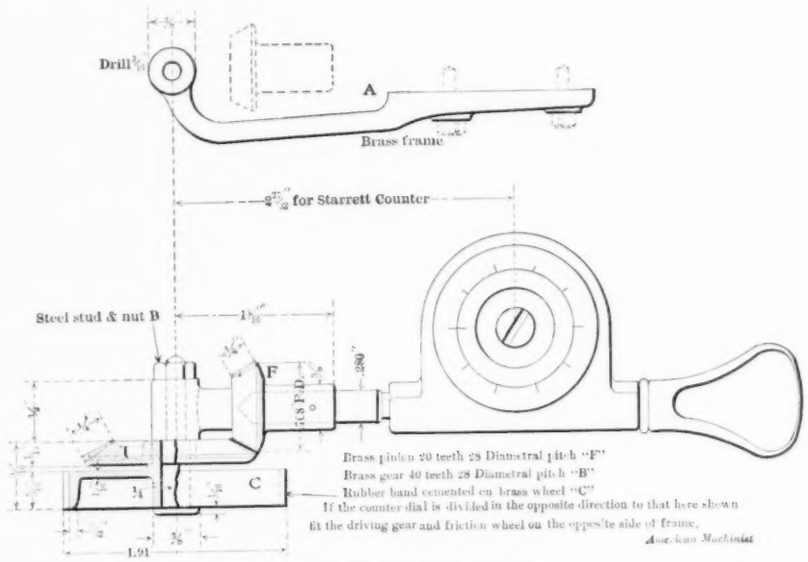
A Simple Cutting Speed Indicator for Machine Shop Use.

Editor American Machinist:

At the present day a foreman or a superintendent in the machine shop should find a cutting-speed indicator almost as necessary as a lead pencil or a 2-foot rule. Some of these instruments are quite expensive to purchase, and so I have devised a very simple and easily made attachment to a speed indicator, as shown by the cut, where the dimensions are given in full. Of course this can be done to fit any make of speed indicator, but it is here shown attached to a "Starrett" revolution counter. It consists simply of the frame *A*, of brass, supporting stud *D*, upon which freely runs the small brass wheel *C*. On the hub of *C* is fitted tightly the forty-toothed bevel gear *D*, which in turn operates the bevel pinion *F*, of twenty teeth, which is pinned on to the driving spindle of the counter. On the brass wheel *C* is fitted and cemented a rubber band *E*. This rubber band is such as is commonly used to hold papers together, and the wheel *C* is made of such a size that the outside of the wheel over the rubber will be 1.91 inches in diameter. When this is held against the piece of work rotating in the lathe the wheel *C* therefore makes one rotation for every 6 inches that the work travels past the tool, and the driving spindle of the counter will make one rotation for every foot that the work travels past the cutting tool. The speed indicator thus shows directly the number of feet the work travels, and by using this in connection with a watch in the usual manner the speed of the work in feet per minute is read off the dial directly.

Simply for a foreman to have one of these indicators in his pocket and to occasionally step to a machine and try the speed, will in many shops have a beneficial effect. It is useful as a ready and cheap means of comparing the shop values of different kinds of steel. For work on a planer this instrument must of course be lifted off the work during the back stroke.

F. W. SALMON.


Drill
A
Brass frame
for Starrett Counter
Steel stud & nut B
F
C
Brass pinion 20 teeth 28 Diametral pitch "F"
Brass gear 40 teeth 28 Diametral pitch "B"
Rubber band cemented on brass wheel "C"
If the counter dial is divided in the opposite direction to that here shown
fit the driving gear and friction wheel on the opposite side of frame.
American Machinist
1.91

A CUTTING-SPEED INDICATOR.

A Templet for Section Lining Tracings.

Editor American Machinist:

A camel-hair brush is an awkward tool in the hand of the average tracer. It has a knack of straying from the straight path and generally behaves in an independent manner, with disastrous results.

An otherwise perfect tracing will appear untidy if the colored section lines on the back are not evenly spaced and of equal thickness. With a templet the most clumsy workman may turn out a creditable bit of sectioning.

A serviceable templet may be made of a piece of very stiff paper, about 5 inches square, having suitably spaced slots cut in it at 45 degrees. The bottom edge of the templet should have a narrow piece of veneer glued on each side in order to prevent its running under the blade of the T-square. When using the templet care must be taken to have the color somewhat dry on the brush. R. D.

England.

As to the Origin of a Shaper.

Editor American Machinist:

We presume in illustrating at page 454 under the heading of "Some New Things," a motor-driven crank shaper, just brought out by the American Tool Works, of this city, you have overlooked the fact that this shaper is a close copy of one we brought out in January, 1901, and which you illustrated at page 515, Vol 24. Note the extension to the base, in both directions, the position of the motor, the four-step cone drive, through a small pinion meshing into the large gear, on the shaft carrying in the regular belt driven shaper the four-step cone pulley. Then note the outer or fixed jaw of the vise extending down to the tables. In fact the general close similarity.

We esteem this a tribute to the merits of our shaper, yet feel that in justice to ourselves you publish this letter, together with reproduced cuts of the two machines, that your readers, who do not recall the original article, may know who are the originators of the tool.

THE CINCINNATI SHAPER CO.,
L. W. Anderson, Secretary and Treasurer.

[We do not consider it necessary to reproduce the illustrations, and prefer not to take up space in that way. Those who are interested can refer to the pages named.—Ed.]

Legal Notes.

BY E. P. BUFFET, LL. B.

WHAT CONSTITUTES "SATISFACTION"—A DISTINCTION MADE UNDER THE MASSACHUSETTS RULE.

In the legal notes of the AMERICAN MACHINIST attention has already* been called to the rules of law concerning "satisfactory" performance of a contract. Under the New York theory, if a contractor undertakes to do a certain piece of work, such as repairing a boiler, to the "satis-

*Vol. 23, page 1222; Vol. 24, page 54.

faction" of the other party, the latter is bound to be "satisfied" where a reasonable man would be under the circumstances. To this an exception is made where the work is one which ministers to taste, like painting a portrait. But the Massachusetts courts take a far different view, and hold that in either case a guarantee of satisfaction gives the hirer or purchaser a right to reject the work even if he decides unreasonably, so long as he acts in good faith.

A recent Massachusetts case, however, involving the sale of two steam pumps, comes to a superficially opposite conclusion through making a nice distinction. The Lockwood Manufacturing Company placed an order for these pumps with the Mason Regulator Company, giving specifications as to capacity, materials, mode of construction, etc. The latter concern wrote: "We will manufacture for you two pumps to conform to the specifications which you sent us on the 15th instant, and guarantee the same to work in a satisfactory manner." The Lockwood Company wanted the pumps to fill a contract with the city of Boston, the work to be inspected by a competent person appointed by the city engineer. This inspector, as it proved, rejected the pumps. The Lockwood Company sued the Mason Company on breach of warranty, and declined to let the case go to the jury on the question whether the pumps complied with the specifications and whether the inspector reasonably ought to have been satisfied. The trial court thereupon ordered a verdict for the Mason Company, and this ruling the Supreme Court has sustained. The appellate tribunal (per Knowlton, C. J.) explains that the words "in a satisfactory manner" were used in a general manner as characterizing the working qualities of the pumps, and that the case is to be distinguished from those in which it had been agreed to give satisfaction to a specific person. 66 N. E. Rep., 420.

Something New in Injunctions.

Hitherto members of labor unions have been practically the only people directly affected by injunctions connected with labor disturbances, but Judge Dickinson, of Omaha, on May 12 issued an injunction against the Business Men's Association of Omaha, which in some particulars seems to be even more sweeping than any injunction that has been issued against workmen. This injunction specifically prohibits the business men from doing anything calculated to break up the unions and from boycotting anyone who employs or does business with the unions, its especially novel features being the prohibition of the importation of workingmen for the purpose of breaking up the unions and the prohibition of applications for injunctions intended to help in breaking up the unions. These last two prohibitions are, we believe, something new in injunctions, and the last one is in some cases being interpreted a little more broadly than is probably justifiable, as it is being understood by some to prohibit the business men from applying for injunctions for any purpose. This we do not understand to be the fact, but that it only prohibits them from applying for injunctions for the specific purpose named—that is, with the object of breaking up the unions.

Exports to Canada.

Attention is being called to the fact that a change of form is now necessary in the certificate accompanying goods imported into Canada, and the T. Eaton Company, of Toronto, send out a circular with a form of certificate to be added, which reads as follows:

"Whereas, German goods are subject to a surtax in Canada, I certify that none of the articles included in this invoice are the produce or manufacture of Germany and that the chief value of none of said articles was produced in Germany; save and except all articles opposite which the word 'Germany' is written on this invoice."

American Committee on Standard Specifications for Cast Iron and Finished Castings.

The meeting of organization of the above committee was held in Philadelphia April 23, with an attendance of twenty-three members. After extensive discussion of the general field it was decided that all the work should be done by subcommittees, and these were appointed as follows: Pig Iron, Pipe, Cylinders, Car Wheels, Malleable Cast Iron, General Castings and Methods of Testing Cast Iron. The convention of the American Society for Testing Materials is to be held at Delaware Water Gap July 1, 2 and 3.

New Engineering Hall of the Iowa State College of Agriculture and Mechanic Arts.

Dedicatory exercises of the above named new engineering building were held at Ames, Iowa, May 22. Dr. R. H. Thurston, of Cornell University; W. C. Jones, of Chicago, and M. J. Riggs, of Toledo, also delivered addresses. The exercises were concluded with a reception in the evening.

In the course of an article commenting upon the address of President Parry at New Orleans the *Iron Molders' Journal* says: "We would be equally culpable with Parry were we to contend that organized labor was faultless. It has just such men as Parry in its midst, and they are equally intemperate. In the name of organized labor they sometimes do rash things or assume an arbitrary position; but that would no more justify the condemnation of the entire movement than would the utterances of Parry suffice to condemn all manufacturers and employers of labor or their associations."

According to *The Engineer*, of London, official announcement is made that the price of carbide of calcium in Germany will shortly be reduced from 50s. to 40s. per ton. It is understood that this decision is attributable to the desire of the Continental carbide industry to stimulate the use of acetylene gas for lighting purposes. At the last named price the rate will be about 1½c. per pound.

When Charles M. Schwab, president of the United States Steel Corporation, was touring in Switzerland, he went through one of the wonderful watch-making establishments in Lucerne and bought there five watches for $1,000 each. He has recently announced to his superintendents that he bought the watches to present them to the five who do the best work, looking of course to total results.

It is announced that a new service rifle, or "musket," has been adopted by an army board that has been considering the matter. The new weapon is described as having a barrel only 24 inches long, which is entirely covered with wood to prevent the burning of the soldier's hands when it is rapidly fired. Its caliber is .30 and it weighs one pound less than the present "Krag" rifle, though it is stated that it gives a higher initial velocity, flatter trajectory and greater penetration. This, of course, means a heavier powder charge and much greater recoil.

A short while ago the papers contained the announcement that the Board of Supervising Inspectors at St. Louis had revoked the licenses of some marine engineers who had gone on strike, and it was announced that the engineers would contest this revocation. Since that time owners of steamboats in and around the port of New York have asked for a ruling on this matter and as to whether licenses can be revoked for such reason. The matter has been referred to the Solicitor of the Treasury for an opinion. The inspectors who took this action claimed that a licensed marine engineer cannot remain idle and retain his license unless he has a good excuse. The engineers, on the other hand, demand to know who is to decide what is a good excuse, and contend that the license simply certifies to their ability as engineers, and is not intended to do more than that.

A new mechanical laboratory is now being, or shortly to be, constructed for the Case School of Applied Science, Cleveland, Ohio.

The Indian Textile Journal, reprinting from our columns a portion of "A Mad Metric Medley," by The Canadian Warbler, at page 93, remarks: "We hope this is not the kind of meter of which the use will be made compulsory."

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The Union Engineering Building.

The Engineering Record distinguishes itself by uttering the only discordant note regarding the proposed union building for engineers, and in doing so gives expression to the sentiments of a few mossback members of the Civil Engineers' Society, who have assumed a holier-than-thou attitude, and who seem to only now and then arouse themselves sufficiently to vehemently assert that civil engineers are the only engineers there are, and that any recognition of the alleged fact that there are other engineers would be derogatory to the dignity of civil engineers. Our contemporary closes its string of "flings" and nonsense as follows: "*The Engineering Record* doubts that one member in ten will vote to abandon the present [civil engineers'] house." Our contemporary will have its doubts removed in due time. We have a much better opinion of civil engineers in general than to suppose that any considerable number of them would be so blind as to fail to see the advantages of such joint occupancy of a splended building as is proposed.

In the meantime the preliminary work of arranging to take advantage of Mr. Carnegie's munificent offer is going ahead, and at a meeting held on the evening of May 15 representatives of the governing bodies of the four professional societies and of the Engineers' Club met and adopted a form of resolutions to be introduced and voted upon by the several societies. These resolutions first commit the societies adopting them to joint action in the matter and joint occupancy of the building; authorize the purchase of needed land on Thirty-ninth street, New York; the appointment of a joint committee to have charge of the business; the selection of an architect, and the supervision of construction work.

The U. S. Patent Office Did Grant a Patent for a Perpetual Motion Machine.

Press despatches from Washington announce that a newspaper item claimed that the Patent Office has issued a patent for a perpetual motion device and had highly commended the machine. This has been denied by Commissioner of Patents Frederick I. Allen, who is credited with saying that the office "has not for forty or fifty years given a patent for perpetual motion, and probably never will do so." He goes on to say that the office "will certainly not allow a patent on any so-called perpetual motion device which is made for the purpose of duping and swindling the credulous and uneducated."

With regard to this last remark, we may express our belief that very many perpetual motion devices are made not at all with the idea of "duping and swindling the credulous and uneducated." Most of them we firmly believe are made because the inventor himself is deceived, and his purpose in working on them and in attempting to secure capital for their exploitation is, we believe, often entirely sincere. That is to say, he believes that he can make the machine work and that those who invest their money in it will not be swindled, but will become wealthy thereby. So that if patents are to be issued on perpetual motion in cases where the machine is not invented for the purpose of "duping or swindling" anybody the office may issue a good many of them so far as that is concerned, though we had not understood that it was any part of the function of the Patent Office to inquire into the motives of an inventor.

As regards the question as to whether the office has or has not issued a patent on perpetual motion devices within the last fifty years, we call attention to the fact that at page 849, Vol. 23 (about three years ago) we illustrated the invention of Mr. Fole, which invention is known by the name of "Poleforcia," and on which a United States patent was issued March 8, 1898. This machine, as we showed at the time, is in all its essentials a perpetual motion device. Though it does not claim to operate without the application of outside power, it does distinctly claim that this power is increased by the inert machine. In other words, that the machine gives out more power than is put into it. This to anyone who is at all capable of reasoning on mechanical matters is in every way equivalent to a perpetual motion device, and we therefore claim that the United States Patent Office did on the date mentioned above issue a patent for a perpetual motion device. We so stated at the time, and we repeat that to issue a patent on a machine gotten up with the avowed object of "multiplying power" is essentially the same as issuing a patent for a perpetual motion machine.

The Utility of an Academic or Classical Education.

We have received a copy of a pamphlet bearing the title "The Utility of an Academic or Classical Education for Young Men Who Have to Earn Their Own Living and Who Expect to Pursue a Commercial Life," which is the result of an investigation by Mr. R. T. Crane.

The author's method was to send letters of inquiry to university presidents and graduates and to leading business men, these letters asking for replies to certain questions relating to the observations and experiences of those to whom the letters were addressed. At the beginning emphasis is laid on the fact that the inquiry relates to classical and literary studies only, although the distinction was not always observed in the replies.

The author claims to have proven that not only is a classical education of no commercial value to its possessor, but that it is a positive hindrance—that the young man who enters business in his teens has a better outlook as regards business success than one who enters business after

spending four years in literary study at a college or university.

As our readers well know, we are disposed to have a good deal of sympathy with the view that a literary education has little or no value in the ordinary walks of commercial life, and this for the reason that the qualities which make for business success are entirely outside of and, in their higher sense, superior to anything that can be learned from books. As we said at page 678, vol. 24: "There are doubtless many men who are superior to all formal education, and there are likewise many positions in the industrial world in which formal education gives little help. The great prizes of life are largely of this kind. * * * In other words, education must always hold, as it always has held, a position inferior to natural talent and force of character."

While Mr. Crane sets out to limit his inquiry to general education, he makes no such limitation in his conclusions. In a section on "The Value of Technical Education" we find the following remarkable statement: "Practically all branches of manufacturing business have been brought to such a wonderful state of perfection that there is very little chance for further improvement in them, even by practical men who possess a large amount of experience, combined with good business sense. This being the case, there is surely no opportunity for the technical man, who is notably lacking this latter qualification, to accomplish anything new in the mechanical direction."

We hardly think the progress of technical education will be stopped by this statement of the case. The author wabbles on this subject, however, as in other places he says: "I have never claimed that an expert in this line of work [mining engineering] could be made out of raw material; it is one of the few occupations for which a man needs to be specially trained," and "The importance of technically educated men in mechanical lines of work, aside from electricity, chemistry and mining, has in my opinion been greatly overestimated."

General education is, in our opinion, a small or negligible factor in business life, because the two have so little relation. No education can teach dealing with men in which judgment based on experience is the chief and almost the only factor. Education can teach dealing with things, and hence education for technical pursuits which consist chiefly in dealing with things is of unquestionable value. In this respect education in engineering is exactly parallel with education in medicine. Technical education teaches the student those things which he will need to know in pursuing his vocation which general education does not, and hence one is of commercial value while the other is not.

The author should have extended his inquiries regarding technical education to the personnel of the Pennsylvania Railroad. That great system is, we believe, officered, from president down, almost exclusively by graduate civil engineers, and the standing of the system is a sufficient reference for the advocates of technical education.

At the time of going to press a vote is being taken in the Iron Molders' Union of North America on the question of rescinding a previous resolution adopted by the union prohibiting its officers from becoming members of the National Civic Federation. So far as the vote has gone it indicates that the resolution will be rescinded. Martin Fox, who is at the head of the Iron Molders' Union, has been a member of the Executive Committee of the Civic Federation.

Two large iron works in Brooklyn have locked out their employees as a result of labor troubles or threatened labor troubles. The first of these was the Hecla Iron Works, and their example was followed by the Continental Iron Works. In both cases demands had been made for an increase of wages and for a shorter workday.

The contract for the building of the "Galveston" by the Trigg Shipbuilding Company, of Richmond, Va., has been revoked by the Navy Department, and the vessel will be towed to Norfolk Navy Yard to be completed by the Government. The Trigg Company is in the hands of a receiver, and the work upon the vessel has been very much delayed.

Charles T. Porter is enthusiastic regarding the Union Engineering building and proposes for it the name "Temple of Physical Truth."

Technical Publications.

"A Hand Book on the Steam Engine." By Herman Haeder. Translated from the German, with additons and alterations, by H. H. P. Powles. Third revised English edition. 450 5x7-inch pages, with 1,085 illustrations and 172 tables. The D. Van Nostrand Company, New York; Crosby Lockwood & Son, London. Price $3.

This is a collection of illustrations and tables of dimensions of steam engines, as made by a large number of German and English builders. It is the result of remarkable industry, and contains an astonishing amount of information regarding actual practice in the proportioning of steam engine parts, arranged for quick and ready reference.

"American Trade Index." 455 5¾x8½-inch pages. The National Association of Manufacturers, New York. Price $10.

While, of course, limited to the members of the Manufacturers' Association, this index is, with that limitation, one of the most satisfactory that we have seen. It is divided into five parts, of which the first gives an alphabetical list of the members of the Association (numbering now over 2,000) with a statement of the goods which they produce, together with a list of names and addresses of foreign agents, cable codes used and cable addresses. Part II is an alphabetical list, in English, of the goods manufactured, each line of goods being numbered consecutively and the names of the manufacturers appearing under each line of goods. Part III is a similar list of goods in Spanish, with references to the serial numbers of Part II, while Parts IV and V are similar to Part III, but in German and French, respectively. A Spanish, German or French buyer may thus find the name of any desired article in his own language and turn immediately to the list of manufacturers making that line of goods, the reference giving also the English name of the article. From this he may turn to the alphabetical list of the manufacturers and learn the nearest agent's name and address, the cable codes to be used and the post office and cable addresses of the home house. The price named is to American nonmembers of the association. Each member receives a copy gratuitously and 6,500 copies are sent to a carefully selected list of responsible foreign buyers who are known to the association.

"Modern Machine Shop Tools." By W. H. Van Dervoort. 552 6x9-inch pages, with 672 illustrations. N. W. Henley & Co., New York. Price $4.

As we are informed by the preface, this book is the outgrowth of an attempt to supply information to university students in engineering. It describes in a comprehensive manner the leading ordinary tools and methods of doing work upon them, and to graduates from the high schools, who comprise most students in engineering and who have no shop knowledge of shop work, the book will supply the deficiency as well as a book can. It is a very complete account of modern tools and methods, and to apprentices and to many mechanics of limited experience as well, it will give information regarding many branches of the trade which would ordinarily require a large amount of experience to accumulate. While it is true enough that most of what is here can be found in technical literature, some of it can not be, and only a small portion can be unless one has at hand a very complete file of technical journals. Such very recent developments as differential indexing and helical gearing are taken up, and the author shows in his selection of material, good judgment and a degree of familiarity with shop matters that enables him to write a book of real value. At page 495, however, there are shown some methods of lacing belts which will not do at all, as the author will quickly find out if he will try the method shown. The angles made

by belt lacings must always balance each other. If they do not the pull of the belt will displace the ends sideways until these angles are balanced and that means a belt with a jog at the joint. These pernicious illustrations of wrong belt lacing methods have appeared too often and we regret to see them repeated in a book that is so generally correct.

Inquiry for Machinery.

(166.) We have an inquiry for name and address of manufacturer of the "Ideal" flue cleaner.

Personal.

R. F. Von Doorn, formerly connected with the Struthers-Wells Company, of Warren, Pa., is now general sales manager of the Titusville (Pa.) Iron Company.

W. A. Green, formerly with the Pacific Iron Works, Bridgeport, Conn., has taken the position of superintendent of the Omega Steel Company, of New Haven, Conn.

H. Darbyshire, of Coventry, England, who has made a specialty of grinding operations, and whose writings on that subject we have noticed, is in America and may remain here, at least for some time.

E. H. Wood, for the past twenty-five years superintendent and general manager of the Harwood & Quincy Machine Company, of Worcester, Mass., having retired from active duty, Thomas Cotterill, the present superintendent, has been appointed superintendent and general manager.

Professor Robert S. Miller, associate professor of mechanical engineering at Purdue University, has been elected to a similar position in the newly organized department of engineering at Colorado College. At this institution Dr. Florian Cajori, professor of mathematics, has been elected dean of the school of engineering.

Obituary.

Isaiah P. Wood died in Philadelphia May 9, eighty-three years old. He was known for forty years in Germantown, Pa., as "The Village Blacksmith," working all that period without the loss of a day through ill-health. He retired from business two years ago.

Rynere Van Sickle, said to have been the oldest locomotive engineer, died recently in the almshouse of Winnebago County, Illinois, ninety-six years old. He was a graduate of Princeton University and had an engine on the old Bordentown and Trenton railway.

In the death of Richard Henry Stoddard, poet and essayist, seventy-eight years old, the mechanical world has some interest, from the fact that he was once a worker with his hands, and that while so engaged he was laying the sure foundations for his later career. His father was a sailor who was drowned, and his mother married another sailor. He went to school until he was fifteen, and then was successively a lawyer's clerk, a reporter, a tailor's apprentice, a clerk in a bellows factory, a blacksmith and a molder, following the latter occupation for some time, during which he was an omnivorous reader and a writer of poetry, the latter ultimately leading him into the literary world and ranking him high in the brilliant group of which he was almost the last survivor.

Commercial Review.

NEW YORK, Monday, May 18, 1903.

The machinery trade during the past week was productive of some good orders, in which small lots were conspicuous. Reports from salesmen on the road continue to bristle with assurances of some excellent business in sight, and which cover many lines. The situation in machine tools has not changed any since we recently described it. Of large propositions there has been an absence, but the probabilities are that a different state of affairs can be noted shortly, as some specifications calling for many items are fast getting into shape for submission to the trade. Considerable has been said recently of a probable advance in the price of heavy machine tools, especially in out-of-town centers, but leading interests here assert themselves to the contrary. In wood working tools there has been marked improvement recently, and some reports place that branch of the machinery industry in the most flourishing condition it has been in months. There are some concerns whose present list of orders is of such proportions that not much zeal is displayed in search of new orders, activity for the most part being confined to attending to inquiries. Different conditions are reported from the West.

Not in over a year has so much interest been manifested in the pig iron market as recently. This is because of the fluctuations which have occurred during the past few weeks, and which have resulted in a decline in prices as high as $2 per ton, in which both domestic and foreign brands have figured.

The recession which has taken place has served to bring about considerable discussion as to whether or not it indicates the "turn of the tide" in the industrial prosperity the country has enjoyed during the past few years, and of which, all authorities agree, the iron and steel industry is an unfailing barometer. The daily press has taken the subject up with considerable vim, and in Wall street it forms a theme to which everything else is secondary.

As is usually the case when all-absorbing questions are being discussed, a diversity of opinion exists. Those who argue that recent events need not give rise to any alarm point to the excellent business conditions which exist, and which show all departments of trade to be in a flourishing state. Coming down to the iron and steel industry, they note that many of the furnaces are sold up to September; that while production has increased consumption is keeping pace with it; that foundrymen are constantly in receipt of good orders; that rail mills are well sold up in the year; that the same thing can be observed of plates; that the demand for structural material continues good, and last, but not least, that independent mills are forced to go abroad for their steel. All these things, they contend, augur well for the continuance of the prosperous conditions which have obtained in the iron and steel industry during the past few years.

As for the negative side of the question, great stress is laid on the reductions which have recently been made on the price of irons. In a previous article we considered the reasons assigned for it, and stated then that consumers interpreted it as indicating that prices would still go lower. That belief exists as strongly today as it ever did, so much so that all of the buying nowadays is confined to meeting immediate requirements. The idea of buying for forward delivery seems to have temporarily lost its prestige, and the spectacle is presented of foundrymen having enough orders on their books to keep their plants occupied for months, without enough iron on hand or contracted for to fill one-third of them, according to some conservative estimates which have been made. Consumers are telling producers that they will not do any business with them for extended delivery unless they make still further concessions, which producers refuse to do as a whole, but that some of them are doing it recent declines bear witness.

The question, therefore, hinges on the price consumers are willing to provide for future requirements. Necessity alone, in the opinion of many, will determine it. Producers say that the time is fast approaching when founders will be compelled to abandon their present waiting policy because of the pressure which will be brought to bear on them to execute their orders. Producers insist that that time will come, and when it does the sagging tendency of pig iron will disappear. In proof of their contention they call attention to the fact that present conditions in pig iron are identical with those which prevailed in sheet steel a few months ago. Prices were declining rapidly, and buyers held off from purchasing extensively because they believed still further recessions would take place. All of a sudden necessity forced them into the market, prices soared and deliveries stiffened to such an extent that some buyers cheerfully paid premiums for prompt shipment. Producers expect a similar fate to befall foundrymen, who are now pursuing the policy we have already noted.

In the meantime foreign irons have been eliminated from this market, in which for months they were a controlling factor. Their future will have an important bearing on prices for domestic material for the remainder of the year. Should the foreign furnaces adopt a lower schedule of prices American producers will be compelled to meet it, so far as seaboard business is concerned. Foundrymen in the East look for something like this to occur, and it forms one of the chief arguments they advance when they claim that still lower prices will prevail.

Summing up the whole situation, the consensus of opinion seems to be that recent developments in the iron and steel industry are chiefly important in that they represent the substitution of normal for abnormal conditions, and that so far as giving cause for apprehension they should be regarded as "a consummation devoutly to be wished."

The Christensen Engineering Company's constantly growing business has made it necessary for the company to provide increased office facilities in Chicago; consequently a large office, fully equipped with every convenience, has just been opened in the Old Colony Building, where representatives of both the air brake and electrical sales departments will be pleased to welcome the customers and friends of the company. Mr. Charles G. Burton, manager of the Chicago agency for the sale of the company's "Ceco" electrical machinery, has removed from the Merchants' Loan and Trust Building into the new office. The air brake department is in charge of Mr. J. E. Eldred, Jr., who is well known in the electric railway field, having for a considerable time represented the company in the sale of air brake equipments.

The Philadelphia Pneumatic Tool Company reports having recently furnished all the pneumatic tools for the erection of forty-five steel bridges that the Southern Pacific Company are erecting incident to the straightening of their line between Ogden, Utah, and Reno, Nev. Large orders for chipping hammers, riveters and drills have been received also from the Baldwin Locomotive Works, American Car & Foundry Company, Pennsylvania Steel Company, American Bridge Company, Vulcan Iron Works, Toledo, and the Lake Shore & Michigan Southern Railway.

CHICAGO MACHINERY MARKET.

A fair number of small machine shops are starting up at Chicago and vicinity and are being equipped with outfits of machinery. Some are making a specialty of repair work, some are manufacturing special articles, one is getting out a new bicycle, a hill climber, and two automobile manufacturers are branching out in business. But, generally speaking, the trade in machine tools at Chicago locally is not so good as that which drifts in from outlying towns. There is a strip of territory running west to the Missouri River which has lately been developing considerable business. Michigan is not a bad State commercially just now, especially in centers like Grand Rapids and Kalamazoo. And the Northwest is a fair purchaser of shop equipment.

The general impression is that business in the machine tool line is relatively quiet this month, but whether it might properly be so considered aside from comparisons with the most active period which the trade has known is not so certain. Fewer customers now visit the various warehouses and stores where the machines they want may be seen, but the mail order trade is fair and salesmen who are out on the road are making some fair returns for their time so employed. It is mainly a pick-up business, few, if any, large inquiries having appeared lately. Those of the Santa Fé and Chicago & Eastern Illinois roads, which were made some weeks ago, have, it is stated, not yet been placed. One or two large sellers in this territory say that during the past week or ten days orders have improved over what they had been for several weeks previous, but this is not the general observation. A few shops are idle because of unadjusted wage scales, but the idleness is only a small portion of the shop capacity that is continuously engaged. It seems to be a waiting period. Reports that reach the local representatives of Eastern toolmakers are to the effect that the factories are extremely busy, or were at the latest advices.

The makers of woodworking tools are participating in the lull of trade. One reason for this is that May is usually a dull month, workers of wood now being at the height of their activity, having already purchased the machinery required for this season of rush. The outlook for the building trades, however, is not so bright as it has been, and if it continues unfavorable will probably exert a slackening influence of the woodworking machine tool business.

There is corresponding quiet in the Western markets for the metals, but the view that is generally taken here of that situation is that the wavering of prices has contributed more to the backwardness of buyers than any serious reduction in the demand, and that a period of returning activity is one of the probabilities in the early future.

Quotations.

NEW YORK, Monday, May 18.

New York prices for Northern and Southern irons for nearby delivery are as follows:

Northern:		
No. 1 X	$21 50 @	$21 75
No. 2 X	20 50 @	20 75
No. 2 plain	19 75 @	20 25
Southern:		
No. 1 Foundry	21 50 @	21 75
No. 2 Foundry	20 50 @	20 75
No. 3 Foundry	19 50 @	19 75
No. 4 Foundry	19 00 @	19 25

Bar Iron—Base sizes—Refined brands, mill price on dock, 1.85c. upward in carload lots. Smaller quantities from store, 2.00 to 2.15c.

Tool Steel—Base sizes—Good standard quality, 7c.; extra grades, 13c. and upward.

Machinery Steel—Base sizes—From store, 2.05 @ 2.10c.

Cold Rolled Steel Shafting—2.90c. from store for base sizes.

Copper—Lake Superior ingot, 14¾ a 15c.; electrolytic, 14¾ @ 15c.; casting, 14½ @ 14¾c.

Pig Tin—In 5 and 10-ton lots, f. o. b. New York, 29.75 @ 30c.

Pig Lead—4.37½c. for carload lots.

Spelter—5.60 a 5.75c.

Antimony—Cookson's, 7⅝ @ 7¾c.; Halletts, 6¾ @ 7c.; other brands, 6½ @ 6¾c.

Lard Oil—Prime City, 79 to 81c., according to brand and quantity, ranging from one barrel up to large lots.

New Catalogs.

Moore & White Company, Philadelphia, Pa. "Transformed Cone Pulleys"; circular.

C. W. Hunt Company, West New Brighton, N. Y. Foundry ladle cars; Catalog No. 032.

Mueller Machine Tool Company, Cincinnati, O. Plain radial drills; circular No. 2.

Rand Drill Company, New York. Circular illustrating "Imperial" air compressor and pneumatic tools.

Phosphor-Bronze Smelting Company, Philadelphia, Pa. Phosphor-bronze and alloys. Price list No. 21. 3½x6, pp. 19, paper.

Westinghouse Electric & Manufacturing Company, Pittsburg, Pa. Westinghouse automobile charging outfits. Circular No. 1061.

Morgan Motor Company, Worcester, Mass. Power trucks, with illustrations and descriptions of principal parts. 5x7, pp. 16, paper.

American Blower Company, Detroit, Mich. Small booklet describing the "A B C" Moist Air System adapted to the drying of lumber.

The Marine Engine & Machine Company, Harrison, N. J. "Alco-Vapor Launches," described and attractively illustrated. 6x9, pp. 12, paper.

Quigley & Krastin, Philadelphia, Pa. Booklet showing automatic revolving jaw chucks, adjustable collapsing taps and adjustable self-opening dies.

The Cutler-Hammer Manufacturing Company, Milwaukee, Wis. Bulletin No. 32, containing description and price lists of "C. & H. Field Regulators."

E. E. Hanna, 550 North Halsted street, Chicago, Ill. Catalog No. 1, pneumatic screen shakers; Catalog No. 2, automatic machinists' vises. 6x9, paper.

Edwin B. Stimpson & Son, 31 Spruce street, New York. Perforated sheet metal, illustrated by reproductions from perforated sheets. 5½x7½, pp. 43, paper.

The Garvin Machine Company, New York. "Machine Tools," a little booklet illustrating some representative machines made by this company. 3½x6, pp. 23, paper.

Sprague Electric Company, New York. Bulletins No. 101 and No. 102 of direct-current generators of the single field coil type and of the split-pole type, respectively.

Wagner Electric Manufacturing Company, St. Louis, Mo. Bulletin No. 56, "Motor Gen-

erator Sets," and Bulletin No. 60, "Single-Phase Alternating Current Power Motors."

August Meltz, 126-128 Mott street, New York. The "Meltz & Weiss" gas and gasoline engines, fully illustrated, with views of installations for various purposes. 6x9, pp. 24, paper.

H. W. Johns-Manville Company, 100 William street, New York. "How to Pack Gas Engine Cylinder Heads"; a little folder which will be of service to those having this class of work to do.

The Goulds Manufacturing Compnay, Seneca Falls, N. Y. "How to Spray, What to Spray and What Pumps to Use." Descriptive of the Goulds spraying pumps and outfits. 4x8½, pp. 39, paper.

Betts Machine Company, Wilmington, Del. Slotting machines; Catalog No. 14. Photographs are shown of 10, 15, 21 and 24-inch slotting machines, and general specifications of each size are given. 7x10, pp. 10, paper.

The Combination Rubber & Belting Company, Bloomfield, N. J. Vulcanized rubber goods adapted to mechanical purposes, including rubber belting, packing, hose rubber rolls and molded goods. 5x7½, pp. 84, paper.

Baldwin Locomotive Works, Philadelphia, Pa. Record of recent construction, No. 41—"Some Notable Trains." Contains reproductions of some remarkable photographs of railway trains. 6x9, pp. 35, paper, with handsome cover design.

Joseph Dixon Crucible Company, Jersey City, N. J. Souvenir of an inspection trip made by the American Society of Civil Engineers to the new terminal of the North German Lloyd Steamship Company, January 21 and 22, 1903.

Sprague Electric Company, New York. "Interior Conduit," iron armored, brass armored, unarmored, flexible metallic and armored cables, with a complete line of conduit fittings and accessories. Catalog No. 410. 7x9¼, pp. 123, paper.

National Engine Company, Rockford, Ill. Description of construction and instructions for erection and operation of the vertical gas and gasoline engine, type "A," reproducing a number of drawings showing the engine in detail. 7x10, pp. 27, paper.

Ateliers Demoor, 290 Chaussee d'Anvers, Brussels, Belgium. Lathe tool carriages for automatically turning the tires of railway rolling stock and other patented machine tool specialties for the same class of work. 8½x5¼ inches, 15 pp., paper.

Crocker-Wheeler Company, Ampere, N. J. Bulletin No. 31, type "D" machine; No. 34, motor driven rotary planer; No. 51, motor driven printing presses; No. 52, motor driven grinder; No. 53, motor driven compressor; No. 54, countershaft motors.

The Binsse Machine Company, Newark, N. J. "The Tool for Quick and Accurate Boring." Catalog No. 2, 1903, of the "Binsse" horizontal boring mahine, showing a number of views of drilling, boring and facing work in this machine. 5x7¾, pp. 31, paper.

The Adams Company, Dubuque, Iowa. "Farwell" molding machines, including stationary and portable molding presses, universal molding machines, stool plate molding machines, automatic molding machines, with accessories and parts. Detailed information is given regarding the construction and operation of the many machines illustrated. A number of pages are devoted to the reproduction of representative patterns. These patterns are numbered, and by means of tables of sizes the machines best adapted to the handling of the different classes of work can be selected. The various operations and uses are so well illustrated and so clearly described that the catalog might almost be termed a text book on molding machines. 6x9, pp. 62, paper.

Manufacturers.

The Knox Woolen Company, Camden, Me., will build an addition.

The Columbus (O.) Wire & Iron Works have bought a factory site.

The East Webster (Mass.) cambric mill of H. N. Slater estate is to be enlarged.

An addition to the Tivoli Brewing Company's plant, Detroit, Mich., is planned for.

E. J. Martin's Sons, Rockville, Conn., are to build an addition to their fish line factory.

The Canfield Gas Engine Company, Binghamton, N. Y., plans to build a larger factory.

Additions are to be built to the plant of Dill & Collins Company, paper manufacturer, Philadelphia, Pa.

A silica factory, with cooper shops, is about to be built at Jonesboro, Ill. H. S. Frost will be manager.

The Mueller Bros.' Art & Manufacturing Company, Chicago, Ill., proposes to erect a large factory building.

Robert Suitor & Sons will build a lumber mill at Linnton, near Portland, Ore.; daily capacity, 150,000 feet.

The Strohauer Medicine Company, Caro, Mich., expects to add facilities for making its own boxes and cartons.

The Ostby & Barton Company, Providence, R. I., manufacturing jewelers, are about to build a factory addition.

Ernest George and Luis Gavagine propose to build a factory in the city of Mexico for the manufacture of steel files.

The Leavitt Manufacturing Company, of Tuscola, Ill., manufacturer of farm implements, etc., will move to Urbana.

About $1,000,000 will be spent on the enlargement of the shops of the Lehigh Valley Railroad Company at Sayre, Pa.

Fred Olney, of Rome, N. Y., has completed negotiations for the purchase of land in Albion as a site for a canning factory.

The Fred Macey Company, office furniture, etc., Grand Rapids, Mich., will probably carry out plans for extensive enlargement.

An addition will be built to the factory of S. W. Evans, Frankford, Philadelphia, manufacturer, we understand, of brass goods.

John Krauft, of Kansas City, is said to be figuring on establishing a boiler manufactory, machine shop and foundry in Enid, Okla.

The E. L. McClain Manufacturing Company, Greenfield, Ohio, is about to erect at Cartersville, Ga., a cotton mill, 600x125 feet.

The Buffalo (N. Y.) Gasoline Motor Company, which will make horseless vehicles and motors for the same, has bought property for a plant.

The Godell-Pratt Company, manufacturer of small tools, Greenfield, Mass., has contracted for the erection of a 40x80-foot, three-story addition.

J. F. Bidstrup & Co., electricians, New York city, owing to increase of business, have removed to 32 Frankfort street, opposite their old office.

The Chamber of Commerce, Wichita, Kan., is working on a proposition of an Ohio firm to build a $75,000 plant to manufacture tile, brick, etc.

We understand that an additional building, 38x100 feet, is to be erected at the River Works of the General Electric Company at Lynn, Mass.

The Washburn-Crosby Company, Minneapolis, Minn., may build a 50,000 or 75,000 bushel cement and tile grain elevator at Louisville, Ky.

George G. Alig, president of the Home Stove Company, of Indianapolis, and others will establish a stove foundry and factory at Greenfield, Ind.

An addition is being built to the factory of the Barrows Lock Company, manufacturer of builders' hardware and metal specialties, Lockport, N. Y.

The contract has been let for a shop, 123x178 feet, with addition, 67x30 feet, at the plant of W. K. Mitchell & Co., pipe fittings, etc., Philadelphia.

A repair shop and two cranes will be contained in car barns planned for by the Rochester (N. Y.) Railway Company back of the Glen Haven station.

John Mahar, builder of engines and boilers, machinist and blacksmith, Tonawanda, N. Y., is building an assembling department, 87x24 feet, to be equipped with machinery.

The Niles (Mich.) Automobile & Gas Engine Company has been organized with a capital stock of $25,000. A factory building will be erected and 100 skilled mechanics put to work.

A new boiler and engine room are being added to the Abingdon (Ill.) Wagon Factory. A new factory building, 80x260 feet, used for making and painting wagon boxes, is to be erected soon.

The Finn Coal Company, which is to operate at Carbondale, Pa., has been formed. Wade M. Finn., of Scranton, is president. A new breaker with a capacity of 300 tons a day is to be erected.

The Clyne Mailing and Machine Company has secured a plant at Troy, N. Y., to manufacture machines to wrap, paste and address papers and megazines. John J. O'Hare is the promoter in Troy.

C. B. Pride, Appleton, Wis., has a contract to plan and build a large pulp and paper mill at Rhinelander. It involves an expenditure of $600,000, with $100,000 addition for improvement of the power.

The Wheeling Corrugating Company, manufacturer of tin plate, roofing and galvanized iron fixings, is preparing to move its Chattanooga, Tenn., plant into larger quarters. New machinery will be installed.

The town of Hudson, Mass., has just voted to install an additional 250-kilowatt, direct-connected engine and generator at the municipal light and power plant, and has appropriated $12,000 for the same.

The Northern Wire & Cable Company expects to erect a factory at Milwaukee, Wis., for the manufacture of cables and electrical supplies. Some of the machinery has been ordered from New York concerns.

H. Bickford and William Nelson, under the firm name H. Bickford & Co., have succeeded to the business formerly conducted by H. Bickford at Lakeport, N. H., for the manufacture of boring and turning mills.

The contract has been let for the erection of a new $300,000 plant of the Hale & Kilburn Manufacturing Company, furniture manufacturer, Philadelphia. One of the buildings will be a machine shop, 204x70 feet.

The Eastern Steel Foundry Company, recently chartered, will build a plant on the Delaware river front in Eddystone, near Chester, Pa. Six or eight hundred men will be employed. John T. Dutcher is named as president.

A $300,000 steel foundry may be built at Newcastle, Pa. Among those said to be interested in the project are David Jameson, cashier of the Citizens' National Bank; John P. H. Cunningham, Charles J. Kirk and Crawford Hoyt.

The Arlington Company, manufacturer of plastic compounds, Arlington, N. J., has purchased land for eventual additions to its plant. A new "mecnanical department," separated from the factory proper, is reported to be in prospect.

The Ludlow Valve Manufacturing Company, Troy, N. Y., has purchased nine acres of land with several buildings on it. It is proposed to build a new foundry, 380x150 feet and other structures. The cranes will be operated by electricity.

The Indiana Foundry & Machine Company, South Benu, Ind., has capitalized at $10,000 to do a general foundry and machine business. Jas. Bergan is president; A. A. Forsyth, vice-president and general manager. A plant is to be put up at South Bend.

The Cumberland Granite Brick Company, of Allegany County, has been incorporated at Cumberland, Md.; incorporators, Warren C. White, Frank A. Blaul and others. The company will erect works in Cumberland and manufacture pressed bricks and tiling.

The Troy (N. Y.) Fireproofing Company has been organized with a capital of $50,000; president, David Morey; secretary, Frederick B. Jillson. The purpose is to manufacture hollow brick and partition blocks. The company is negotiating for a site for a plant.

The I. & M. Canning Company has been incorporated at Minneapolis, Minn. This company will manufacture tin cans and put up vegetables. A plant costing $100,000 will be established. The incorporators are R. R. Odell, Otto Manson and William N. Webster.

The F. M. Whiting Company, North Attleboro, Mass., will erect a building to be occupied by the jewelry manufacturers, R. Blackington & Co. and Sturtevant, Whiting & Bigelow, both of that place; also, according to one report, by Maintien Bros. & Elliot, of Plainville, Mass.

The Stewart boiler works, Worcester, Mass., have begun the erection of a new building of 120x68 feet, in addition to their plant. The upper story will be used as an erecting shop and in it will be a 20-ton traveling crane. On the lower floor will be a small machine shop and storeroom.

The E. R. Wagner Manufacturing Company, manufacturer of vehicle hardware, sheet metal stampings and hardware specialties, North Milwaukee, Wis., is building a fireproof iron warehouse, 40x100 feet. During the past year its business in the line of sheet metal stampings has increased very largely.

It is reported that the Simplex Railway Appliance Company, Chicago, Ill., will enlarge its plant at Montreal, Canada., which was opened last July for the manufacture of steel cars, trucks, bolsters and other railway appliances, and that a new plant will be erected along the line of the Canadian Pacific Railway.

The city of Bordentown, N. J., which is located on the Delaware River and the Raritan Canal and has railroad facilities as well, is inviting manufacturing establisaments. Thomas Noon is a member of the committee of the Council appointed to secure such manufacturers. He will be glad to give information regarding the advantages of Bordentown.

The Hays Manufacturing Company, gas, water and steam specialties, Erie, Pa., is preparing for the erection of a $60,000 plant. Plans were being prepared by Architect F. Felkel, of Pittsburgh. Three manufacturing buildings are contemplated. The machine shop will be two stories, 60x200 feet; the foundry, 70x160 feet, and the power-house and boiler-room, 30x60 feet.

The Stromberg-Carlson Telephone Manufacturing Company is planning to erect another big building at its Rochester, N. Y., plant. It will be 270x340 feet and cost $85,000; with the equipment about $200,000. The company proposes to remove its telephone factory from Chicago to Rochester. At present lead cable, insulated wire and wire cable are manufactured at Rochester.

The Omega Steel Company, New Haven, Conn., has just been organized with a capital of $3,000,000, and bought the National Tool Company, of New Haven, Conn. C. J. Berham is president and treasurer. The company is equipping a large plant on East street, and, in addition to making Omega steel, will manufacture a full line of lathe and planer tools, reamers, taps and milling cutters.

The Union Manufacturing & Power Company has awarded the contract for constructing a 10,000 horse-power house and dam at Neals Shoals, near Union, S. C. The first use of this power will be by the Union (S. C.) Cotton Mills, which will adopt electricity. Thomas C. Duncan is president of the two companies named. It is understood that he and associates contemplate building additional cotton mills.

Owing to the demand for its universal patternmakers' and toolmakers' vises, the Emmert Manufacturing Company, Waynesboro, Pa., is compelled again to increase its facilities and is erecting a two-story building, 40x65 feet, and a one-story building, 45x125 feet, for additional machine-shop room. It expects to be in the market within the next sixty or ninety days for a complete line of machinery supplies for equipping these shops.

The American Foundry Company, Columbus, Ind., has been incorporated; capital, $10,000; incorporators, Marshall T., Milton O., and Gernie L. Reeves and others. The main building will be a 56x112-foot foundry, and other structures will be erected. The foundation of the plant is now being laid. It is understood that the concern will at first turn itself chiefly to producing material for the Reeves Pulley Company, but may later drift into the general transmission manufacturing line at its own plant.

Miscellaneous Wants.

Advertisements will be inserted under this head at 25 cents a line, each insertion. Copy should be sent to reach us not later than Saturday morning for the ensuing week's issue. Answers addressed to our care will be forwarded.

Grant. Gears. See upper corner, page 62.

Caliper cat. free. E. G. Smith, Columbia, Pa.

Punches & dies. Wal.M.Wks., Waltham, Mass.

Patterns.—Cincinnati Pat. Wks., Cincin., O.

Drawings, patterns and models to order. Ashland Tool Co., Ashl.nd, Pa.

Inventions developed. G. M. Mayer, M. E., Monadnock Block, Chicago, Ill.

Make your own auto. for $25; plans 50 cents. A. McHarg, 15 Dey, New York.

Wanted—Improvements in grinding machinery. Address Box 1435, Providence, R. I.

Will buy or pay royalty for good patented machine or tool. Box 282, AMER. MACH.

Light and fine mach'y to order; models and elec. work specialty. L. O. Chase, Newark, N. J.

Automatic machinery designed and constructed by the Wellman Sole Cutting Machine Co., Medford, Mass.

Wanted—Air compressor, new or second hand, steam driven, 400 cu. ft. capacity. Box 276, AMERICAN MACHINIST.

Special and light machinery, models; subpress and blanking dies a specialty, also fine tool work. Box 250, Waterbury, Conn.

Machine shop desires connection with reliable parties requiring building of machinery. Box 298, AMERICAN MACHINIST.

Wanted—Competent managers, superintendents and foremen. James Brady, Room J, 20th Floor, 220 Broadway, New York.

Designing auto. mach'y tools for interchangeable work a specialty; drawings made at moderate prices. Box 943, New Haven, Ct.

Machinists—Send 10 cents for blueprint table of U. S. S. steam, gas and water pipe, giving tapping sizes. E. E. Meyer, Allegheny, Pa.

Extra work—drawing or figuring—wanted by experienced electrical and mechanical engineer; graduate. Box 292, AMERICAN MACHINIST.

Wanted—Contract and jobbing work on medium and heavy weight machinery and parts; prompt delivery. U. S. Rapid Fire Gun & Power Co., Derby, Conn.

We make designs details, working drawings and neat tracings from mechanical ideas or sketches furnished, with reasonable rates. Room 409, La France Bldg., Holyoke, Mass.

Draftsmen desiring occasional extra business in line with drafting; state where regularly employed; confidential. Address Edwin Guthrie, Corcoran Building, Washington, D. C.

Wanted—To correspond with a practical oil-country mechanic and business man, with some capital, who might desire to acquire a working interest in a growing and successful manufa turing and jobbing foundry and machine shop business. Address "Ohio River," care AMERICAN MACHINIST.

Wanted—A first-class man to take a responsible position in a modern machine manufacturing plant, in a desirable city of one of the Middle States; must have had experience in manufacturing sewing machines, gun work or some light, high-grade machine manufacturing; must be familiar with the most advantageous ways and means of manufacturing by the use of modern, up-to-date machinery, fixtures and methods; a man of ability and character, who has had experience and is a good manager of men, who is systematic, broad gage and knows how to get results, can secure a good, permanent position; state age, experience, references and salary wanted. Write full particulars to Box 268, AMER. MACHINIST.

For Sale.

For Sale—Complete set of patterns, drawings, blueprints and some gages for heavy vertical spindle milling machine; will accept reasonable price and give good reason for selling. Address Box 297, AMER. MACHINIST.

For Sale—An established and successful machinery manufacturing business in a town of 10,000 inhabitants; modern brick buildings, fine water power, good shipping facilities, etc.; satisfactory reasons for selling; a grand opportunity to the right party who can invest not less than $100,000 after the fullest investigation. Address "Machinery Manufacturer," care AMERICAN MACHINIST.

Wants.

Situation and Help Advertisements only inserted under this head. Rate 25 cents a line for each insertion. About six words make a line. No advertisements under two lines accepted, and no advertisements abbreviated. The cash and copy should be sent to reach us not later than Saturday morning for the ensuing week's issue. Answers addressed to our care will be forwarded. Applicants may specify names to which their replies are not to be forwarded; but replies will not be returned. If not forwarded they will be destroyed without notice. Original letters of recommendation or other papers of value should not be enclosed to unknown correspondents. State mentioned indicates present address of advertiser.

Situations Wanted.

CONNECTICUT.

Mechanical engineer, technical graduate, with 18 years' practical experience, expert designer of tools, dies and fixtures for the manufacture of interchangeable parts, automatic machine tools, gas engines, etc., desires position as superintendent, chief draftsman or designer. Address Box 301, AM. MACH.

ILLINOIS.

Mechanical engineers want positions; we have investigated their records and can furnish competent men for all kinds of technical work. Engineering Agency, Chicago.

INDIANA.

Wanted—Position as general foreman or superintendent; man of extensive experience on special machinery, gas engine and tool building, a thorough, practical man and a hustler, desires a change; age 37; reference; go anywhere. Address Box 304, AM. MACH.

MAINE.

Expert cost accountant and methodizer will be open to an engagement July 1; unquestionable reference. "Method," care AM. MACH.

MICHIGAN.

Experienced foreman desires position as foreman or superintendent with reliable concern manufacturing automobiles; understands modern methods of conducting shop and handling men successfully and with profit; a good designer and a thorough mechanic; first-class references. Address Box 290, AMER. MACH.

NEW JERSEY.

A present manager in an incorporated ma-

chine plant would like to locate with some concern which wants a hustler; 12 years' experience in all branches and capable of filling any position from manager down; strong hold designing and building money-saving tools; correspondence solicited; references furnished. Address Box 306, AM. MACH.

NEW YORK.

Machine designer, etc., wants position. Address Box 63, AMERICAN MACHINIST.

Mechanical draftsman, experienced, references, wants position. A. B. C., AM. MACH.

Mechanical draftsman, Swede, graduate of a German university, desires position. Box 310, AMERICAN MACHINIST.

Machinist; toolmaker on fine, accurate work; 5 years in last position; references. Box 302, AMERICAN MACHINIST.

Mechanical engineer, university graduate, many years' experience, with inventive abilities, wants position. Box 303, AM. MACH.

Draftsman, familiar with machinery, mill and furnace work, wishes position in the vicinity of New York. Box 280, AM. MACH.

Draftsman (23), technical education, 5 years' shop, 2 years' drawing-room experience, wants position as detailer. Box 289, AM. M.

Wanted—Position as foreman patternmaker by experienced mechanic, competent to handle both men and work to advantage. Box 277, AMERICAN MACHINIST.

A position as foreman and designer, by a thorough toolmaker, on jigs, gages, compound dies, etc.; 20 years' experience; good references. Box 300, AMERICAN MACHINIST.

Wanted—Position as foreman with reliable concern; varied experience; can handle help profitably and is a thorough mechanic; New York or Philadelphia preferred. Address O. K., care AMERICAN MACHINIST.

Machine shop foreman wishes to make a change; 10 years in present position, handling from 75 to 100 men on heavy machine tool work; first-class references if required. Box 299, AMERICAN MACHINIST.

A practical mechanical superintendent, of wide experience and up in modern shop practice and systems, at present engaged, would like to change; experienced in medium, small and interchangeable work, also in brass goods; good references. Address "Superintendent," P. O. Box 1533, New York.

Situation as superintendent of factory manufacturing machine and wood screws, bolts and nuts, by man with large practical experience in all branches of above business; technical education; capable of designing and building automatic machinery; can handle men to advantage. Box 291, AMER. MACH.

OHIO.

Assistant superintendent or general foreman, with exceptional ability and experience, wishes to make a change. Box 295, AM. M.

PENNSYLVANIA.

Experienced engineer wants position in sales or correspondence department of concern manufacturing steam machinery or steam specialties. Box 311, AMER. MACH.

Help Wanted.

CONNECTICUT.

Wanted—Hot copper sheet roller on miscellaneous sheet, etc., for mill turning out 40,000 to 50,000 lbs. of sheet copper per month and 250,000 breaking down. Address and state wages required and references, Box 296, AMERICAN MACHINIST.

ILLINOIS.

Draftsmen for all classes of work; over 200 actual vacancies for technical men; 5,000 positions filled in 10 years. Engineering Agency, 19 Monadnock Block, Chicago.

We are constantly increasing the scope of our work and invite applications for positions from first-class patternmakers, molders and machinists; we always have vacancies. Address Allis-Chalmers Co., Lock Box No. 1065, Chicago.

MAINE.

Wanted—Expert die sinker of large experience; highest wages or salary to the right man. Address "Drop Forge," care AM. M.

MASSACHUSETTS.

Machinists wanted; good, all-round men on special automatic machinery; good pay and steady work. Apply to L. F. Fales, Walpole, Mass.

Wanted—Immediately three first-class diesinkers for drop forge work. United Shoe Machinery Co., McKay Dept. Factory, Winchester, Mass.

Traveling salesman wanted for a line of special machine tools; must have had good experience and preferably in the line of grinding machinery; please write fully as to age, experience and salary expected. "Grinding," care AMERICAN MACHINIST.

Good mechanical draftsman, of practical shop experience, is wanted by a progressive and growing shop manufacturing machine tools; applicants should state qualifications as fully as possible and mention age and salary expected. "Central Massachusetts," care AMERICAN MACHINIST.

MICHIGAN.

Wanted—A good machinist to work on tools and jigs of a simple character and keep dies in order; also to take the place of regular lathe and boring machine hands when sick or off on business; would prefer a man who has previously had charge of a small shop, as the position offered is practically a working assistant of our present foreman; in answering, write fully regarding experience, stating age, whether married or single and salary expected; all correspondence strictly confidential. Box 308, AMER. MACHINIST.

NEW JERSEY.

Wanted—Expert grinder and polisher for ship work. Ask for Mr. Briggs, Crescent Ship Yard Company, Elizabethport, N. J.

Foreman shop, Plainfield, N. J.; 20 hands; light work; steady position; reference; salary. "Factory," care AMER. MACHINIST.

Foreman wanted; man capable of producing small duplicate parts and handling cheap help; must be a cost-cutter. Box 305, A. M.

Wanted—Lathe and planer hands for night work on heavy machine tool work; good wages to good men. Apply to The Pond Machine Tool Company, Plainfield, N. J.

Business manager wanted, capable of directing large enterprise (plant in New Jersey nearing completion); must possess marked executive ability, sound judgment, tact, energy and aptitude for details; must have a successful record as manager in some manufacturing line where he has organized and controlled advantageously the various departments; manager will have full charge, subject to executive officers; highest references required; very liberal salary to start and chance of increase to one showing results; state age. Address "Portland Cement," Orange, N. J.

NEW YORK.

Wanted—Two good wood pattern makers; state age and experience. The Goulds Mfg. Co., Seneca Falls, N. Y.

Several good draftsmen for permanent positions with a large concern in New York city. Box 223, AMERICAN MACHINIST.

Wanted—First-class lathe hands, all-around machinists and toolmakers; steady work; good pay. H. H. Franklin Mfg. Co., Automobile Dept., Syracuse, N. Y.

Steady work, fair wages and good chance for advancement for a thoroughly good toolmaker on small, interchangeable work; state experience, references, wages and if union man. Address "Opportunity," Box 294, A. M.

Wanted—Immediately, 50 lathe, planer, milling machine and vise hands; steady employment and good wages; we build engine lathes and other machine tools. Apply to or address The W. P. Davis Machine Co., Rochester, N. Y.

Superintendent, with technical education and experience, for manufacturing and foundry departments of large establishment in central New York, manufacturing iron goods, employing 500 to 600 men; state age and experience; only bright and aggressive men need apply. Box 309, AMERICAN MACHINIST.

Machinists wanted in a small manufacturing town, one hour's ride from New York city; wages $2.50 per day of 9 hours; time and a half for over time; factory employs about 300 men; has been in existence over 20 years, during which time it has never reduced wages or laid off men for lack of work; special inducements will be offered desirable men at this time; state nationality, age and experience for past 5 years. Box 200, AM. M.

OHIO.

Patternmakers or men with some experience. Cincinnati Pattern Works, Cincinnati, Ohio.

Wanted—Lathe hands, planer hands, vise hands; milling machine hands; good wages and steady work. Apply to the Harris Automatic Press Company, Niles, O.

Superintendent machine shop, 50 to 75 men; must have energy, executive ability and be familiar with modern methods; state age, experience and salary desired. Box 293, AMERICAN MACHINIST.

Wanted—A first-class designer who has had sufficient experience to assume the responsibility of new designs and who is practical and thoroughly up to date; please give experience, references, age, salary expected. Address Box 307, AMERICAN MACHINIST.

Wanted—An all-round machinist to act as superintendent in a shop, in Cincinnati, doing light manufacturing and special work and employing between 20 and 30 men; applicant must be capable of overseeing machine and vise work and must have had experience as foreman of both; a good opening for an energetic and up-to-date young man. Apply, giving age, whether married and references (which will be treated as strictly confidential), Box 278, AMERICAN MACHINIST.

PENNSYLVANIA.

Experienced mechanical draftsman wanted; permanent employment assured to rapid and accurate draftsman. "Mill Work," care A. M.

Wanted—First-class fitters, experienced on vertical boring and turning mills; good wages and steady employment. Colburn Machine Tool Company, Franklin, Pa.

We are constantly increasing the scope of our work, and invite application for positions from first-class patternmakers, molders and machinists; we always have vacancies. Address The Westinghouse Machine Company, East Pittsburgh, Pa.

First-class, experienced mechanical draftsmen wanted at once; some of them acquainted with electrical work; those with shop experience preferred. Apply, by letter, to Chief Draftsman, P. O. Box 911, Pittsburg, Pa., stating experience in full and giving references.

Wanted—Mechanical superintendent to take entire charge shops, foundry and machine works employing 150 hands, manufacturing automatic cut-off engines and doing general mill and factory repairs; must be thorough in all branches, well up in modern shop practice and capable of producing results; state age, experience and references. "Penna," care AMERICAN MACHINIST.

RHODE ISLAND.

First-class tool or model makers on light, high-grade machinery. Taft-Peirce Works, Woonsocket, R. I.

WISCONSIN.

Wanted—Competent machine and bench hands. The Kempsmith Mfg. Co., Milwaukee, Wis.

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Castings, Die Molded
Franklin Mfg. Co., Syracuse, N. Y.

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Christensen Engineering Co., Milwaukee, Wis.
sonia, Conn.
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Fay & Scott, Dexter, Me.
New Haven Mfg. Co., New Haven, Conn.
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Reed Co., F. E., Worcester, Mass.

Chains, Driving
Boston Gear Works, Boston, Mass.
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Jeffrey Mfg. Co., The, Columbus, Ohio.
Link Belt Engr. Co., Phila., Pa.
Morse Chain Co., Trumansburg, N. Y.
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Chucks, Lathe
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Chucks, Scroll
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Chucks, Split
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Caldwell, Son & Co., H. W., Chicago, Ill.
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Smith, F. L., Franklin Falls, N. H.

Compound, Boiler
Harris Oil Co., A. W., Provi., R. I.

Compound, Pipe Joint
Dixon Crucible Co., Jos., Jersey City, N. J.

Compressors, Air
Blanchard Mach. Co., Boston, Mass.
Chicago Pneumatic Tool Co., Chicago, Ill.
Christensen, N. A., Milwaukee, Wis.
Clayton Air Compressor Works, New York.
Curtis & Co. Mfg. Co., St. Louis, Mo.

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Consulting Engineer
Thompson, Hugh L., Waterbury, Conn.

Controllers and Starters, Electric Motor
Cutler-Hammer Mfg. Co., Milwaukee, Wis.

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Long & Allstatter Co., Hamilton, Ohio.

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Caldwell & Son Co., H. W., Chicago, Ill.
Cresson Co., Geo. V., Philadel., Pa.
Davis Mach. Co., W. P., Rochester, N. Y.
Patterson, Gottfried & Hunter, Ltd., New York.
Stuart, R. J., New Hamburg, N. Y.

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Case Mfg. Co., Columbus, O.
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Northern Engineering Works, Detroit, Mich.
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Pawling & Harnischfeger, Milwaukee, Wis.
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Whiting Foundry Equipment Co., Harvey, Ill.

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Underwood & Co., H. B., Philadelphia, Pa.

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Dixon Crucible Co., Jos., Jersey City, N. J.
Obermayer Co., S., Cincinnati, O.

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Northern Engr. Works, Detroit, Mich.
Obermayer Co., S., Cincinnati, O.
Paxson Co., J. W., Philadel., Pa.
Whiting Foundry Equip. Co., Harvey, Ill.

Cutters, Milling
Becker-Brainard Milling Mach. Co., Hyde Park, Mass.
Brown & Sharpe Mfg. Co., Providence, R. I.
Cleveland Twist Drill Co., Cleveland, O.
Gay & Ward, Athol, Mass.
Ingersoll Milling Mach. Co., Rockford, Ill.
Morse Twist Drill & Mach. Co., New Bedford, Mass.
Rogers, John M., Boat, Gage & Drill Works, Gloucester City, N. J.
Standard Tool Co., Cleveland, O.
Whitney Mfg. Co., Hartford, Conn.

Cutting-off Machines
Bement, Miles & Co., New York.
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Pond Mach. Tool Co., New York.

Cutting-off Tools
Armstrong Bros. Tool Co., Chicago, Ill.
O. K. Tool Holder Co., Shelton, Conn.
Pratt & Whitney Co., Hartford, Conn.

Diamond Tools
Dickinson, Thos. L., New York.
Steel Set Diamond Co., New York.

Dies, Sheet Metal
Bliss Co., E. W., Brooklyn, N. Y.
Hay-Budden Mfg. Co., Brooklyn, N. Y.
Perkins Mach. Co., So. Boston, Mass.

Dies, Threading, Opening
Errington, F. A., New York.
Geometric Drill Co., New Haven, Conn.
Jones & Lamson Mch. Co., Springfield, Vt.
Maines Mach. Co., Philadel., Pa.
Modern Tool Co., Erie, Pa.
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Drilling Machines, Bench
Barnes Co., W. F. & John, Rockford, Ill.
Pratt & Whitney Co., Hartford, Conn.

Drilling Machines, Boiler
Aurora Tool Works, Aurora, Ind.
Baush Mch. Tool Co., Springfield, Mass.
Bement, Miles & Co., New York.
Bickford Drill & Tool Co., Cincinnati, O.
Dallett & Co., Thos. H., Phila., Pa.
Niles Tool Works Co., New York.
Pond Mach. Tool Co., New York.

Drilling Machines, Portable
Dallett & Co., Thos. H., Philadelphia, Pa.
Hisey-Wolf Mch. Co., Cincin., O.

Drilling Machines, Multiple Spindle
Baker Bros., Toledo, O.
Barnes Co., B. F., Rockford, Ill.
Barnes Co., W. F. & John, Rockford, Ill.
Barr, H. G., Worcester, Mass.
Baush Mch. Tool Co., Springfield, Mass.
Bement, Miles & Co., New York.
Bickford Drill & Tool Co., Cincinnati, O.
Dallett & Co., Thos. H., Phila., Pa.
Garvin Mach. Co., New York.
Harrington, Son & Co., Edwin, Philadelphia, Pa.
McCabe, J. J., New York.
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National Automatic Tool Co., Dayton, O.
Newton Machine Tool Works, Philadelphia, Pa.
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Prentiss Tool & Supply Co., New York.
Woodward & Rogers Co., Hartford, Conn.

Drilling Machines, Pneumatic
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Cleveland Pneu. Tool Co., Cleveland, O.
Phila. Pneumatic Tool Co., Philadelphia, Pa.
Railway Appliances Co., Chicago, Ill.
Rand Drill Co., New York.
Standard Ry. Equip. Co., St. Louis, Mo.

Drilling Machines, Radial
American Tool Wks. Co., Cin., O.
Baush Mch. Tool Co., Springfield, Mass.
Bement, Miles & Co., New York.
Bickford Drill & Tool Co., Cincinnati, O.
Cleveland Punch & Shear Works Co., Cleveland, O.
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Fosdick Mach. Tool Co., Cincin., O.
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Drilling Machines, Turret
Niles Tool Works Co., New York.
Quint, A. D., Hartford, Conn.
Vanderbeek Tool Works, Hartford, Conn.

Drilling Machines, Upright
American Tool Wks. Co., Cin., O.
Aurora Tool Works, Aurora, Ind.
Baker Bros., Toledo, O.
Barnes Co., B. F., Rockford, Ill.
Barnes Co., W. F. & John, Rockford, Ill.
Barr, H. G., Worcester, Mass.
Bement, Miles & Co., New York.
Blaisdell & Co., P., Worcester, Mass.
Brown & Zortman Mchry. Co., Pittsburg, Pa.
Cincinnati Mach. Tool Co., Cin., O.
Davis Mach. Co., W. P., Rochester, N. Y.
Fosdick Mach. Tool Co., Cincinnati, O.
Gould & Eberhardt, Newark, N. J.
Harrington & Son Co., Edwin, Philadelphia, Pa.
Hill, Clarke & Co., Boston, Mass.
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Prentiss Tool & Supply Co., New York.
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Washburn Shops, Worcester, Mass.
Whitney Mfg. Co., Hartford, Conn.
Woodward & Rogers Co., Hartford, Conn.

Drills, Center
Pratt & Whitney Co., Hartford, Conn.
Slocomb Co., J. T., Providence, R. I.

Drills, Rail
Bement, Miles & Co., New York.
Niles Tool Works Co., New York.

Drills, Ratchet
Parker Co., Chas., Meriden, Conn.
Pratt & Whitney Co., Hartford, Conn.

Dynamos
C & C Electric Co., New York.
Christensen Engineering Co., Milwaukee, Wis.
Commercial Electric Co., Indianapolis, Ind.
Crocker-Wheeler Electric Co., Ampere, N. J.
Eck Dynamo & Motor Co., Belleville, N. J.
General Elec. Co., New York.
Jantz & Leist Elec. Co., Cincin., O.
Mechanical Appliance Co., Milwaukee, Wis.
Milwaukee Elec. Co., Milwaukee, Wis.
Northern Elec. Mfg. Co., Madison, Wis.
Robbins & Myers Co., Springfield, Ohio.
Roth Bros. & Co., Chicago, Ill.
Sprague Elec. Co., New York.
Storey Motor & Electric Co., Harrison, N. J.
Triumph Elec. Co., Cincinnati, O.
Western Electric Co., Chicago, Ill.
Westinghouse Electric & Mfg. Co., Pittsburgh, Pa.

Electrical Supplies
Commercial Electric Co., Indianapolis, Ind.
General Elec. Co., New York.

Electrical Supplies—*Cont'd*
Milwaukee Elec. Co., Milwaukee, Wis.
Storey Motor & Electric Co., Harrison, N. J.
Triumph Elec. Co., Cincinnati, O.
Western Electric Co., Chicago, Ill.
Westinghouse Electric & Mfg. Co., Pittsburgh, Pa.

Elevators
Albro-Clem Elevator Co., Philadelphia, Pa.
Curtis & Co. Mfg. Co., St. Louis, Mo.
Howard Iron Wks., Buffalo, N. Y.
Morse, Williams & Co., Phila., Pa.

Emery Wheels
See Grinding Wheels.

Emery Wheel Dressers
Calder, Geo. H., Lancaster, Pa.

Enamel, Machinery
Felton, Sibley & Co., Phila., Pa.

Enclosures, Tool-room
Merritt & Co., Philadelphia, Pa.

Engines, Automobile
Olds Motor Works, Lansing, Mich.

Engines, Gas and Gasoline
Backus Water Motor Co., Newark, N. J.
Bay State Gas Engine Co., Boston, Mass.
Foos Gas Eng. Co., Springfield, O.
Middletown Mach. Co., Middletown, O.
Mietz, August, New York.
New Era Iron Wks., Dayton, O.
Olds Motor Wks., Lansing, Mich.
Struthers-Wells Co., Warren, Pa.

Engines, Steam
Buffalo Engine Co., Buffalo, N. Y.
Frick Co., Waynesboro, Pa.
Rand Drill Co., New York.
Struthers-Wells Co., Warren, Pa.

Exhaust Heads
Burt Mfg. Co., Akron, O.

Fans, Electric
General Electric Co., New York.
Northern Elec. Mfg. Co., Madison, Wis.
Sprague Elec. Co., New York.
Western Electric Co., Chicago, Ill.
Westinghouse Elec. & Mfg. Co., Pittsburgh, Pa.

Fans, Exhaust
Buffalo Forge Co., Buffalo, N. Y.

Feed Water Heater and Purifier
Hawley Down Draft Furnace Co., Chicago, Ill.

Files and Rasps
Barnett Co., G. & H., Phila., Pa.
Hammacher, Schlemmer & Co., New York.
Nicholson File Co., Provi., R. I.
Patterson, Gottfried & Hunter, Ltd., New York.

Filing Machines
Cochrane-Bly Mach. Co., Rochester, N. Y.

Fillers, Oil Can
The Winkley Co., Hartford, Conn.

Filters, Oil
Burt Mfg. Co., Akron, O.

Fittings, Steam
Crane Co., Chicago, Ill.
Crosby Steam Gage & Valve Co., Boston, Mass.
Jenkins Bros., New York.
Lunkenheimer Co., Cincinnati, O.
Walworth Mfg. Co., Boston, Mass.

Flexible Shafts
Chicago Flexible Shaft Co., Chicago, Ill.

Forges
Buffalo Forge Co., Buffalo, N. Y.
Miner & Peck Mfg. Co., New Haven, Conn.
Patterson, Gottfried & Hunter, Ltd., New York.

Forgings, Drop
Billings & Spencer Co., Hartford, Conn.
Miner & Peck Mfg. Co., New Haven, Conn.
Wyman & Gordon, Worcester, Mass.

Forgings, Hydraulic
Wyman & Gordon, Worcester, Mass.

Forgings, Steel
Hay-Budden Mfg. Co., Brooklyn, N. Y.
Pittsburg Shear Knife & Mach. Co., Pittsburg, Pa.
Westmoreland Steel Co., Pittsburg, Pa.
Wyman & Gordon, Worcester, Mass.

Foundry Furnishings
Obermayer Co., S., Cincinnati, O.
Paxson Co., J. W., Philadel., Pa.
Smith Fdry. Supply Co., J. D., Cleveland, O.
Whiting Foundry Equip. Co., Harvey, Ill.

Furnaces, Coal and Oil
Buffalo Forge Co., Buffalo, N. Y.
Hawley Down Draft Furnace Co., Chicago, Ill.
Jacobson Mach. Mfg. Co., Warren, Pa.
Obermayer Co., S., Cincinnati, O.

Furnaces, Gas
Am. Gas Furnace Co., N. Y., City.
Chicago Flexible Shaft Co., Chicago, Ill.

Furniture, Machine Shop
New Britain Mach. Co., New Britain, Conn.

Gages, Recording
Bristol Co., Waterbury, Conn.

Gages, Standard
Brown & Sharpe Mfg. Co., Providence, R. I.
Rogers, John M., Boat, Gage & Drill Works, Gloucester City, N. J.
Sawyer Tool Mfg. Co., Fitchburg, Mass.
Slocomb Co., J. T., Prov., R. I.
Starrett Co., L. S., Athol, Mass.

Gages, Steam
Crosby Steam Gage & Valve Co., Boston, Mass.

Gear Cutting Machinery
Becker-Brainard Milling Mach. Co., Hyde Park, Mass.
Bickford Drill & Tool Co., Cin., O.
Brown & Sharpe Mfg. Co., Providence, R. I.
Bultman & Co., F. H., Cleveland, Ohio.
Fellows Gear Shaper Co., Springfield, Vt.
Gleason Tool Co., Rochester, N. Y.
Gould & Eberhardt, Newark, N. J.
Harrington & Son Co., Edwin, Philadelphia, Pa.
Newton Mch. Tool Wks., Phil., Pa.
Niles Tool Works Co., New York.
Whiton Machine Co., D. E., New London, Conn.

Gears, Cut
Bilgram, Hugo, Philadelphia, Pa.
Boston Gear Works, Boston, Mass.
Brown & Sharpe Mfg. Co., Providence, R. I.
Bultman & Co., F. H., Cleveland, Ohio.
Fawcus Mach. Co., Pittsburgh, Pa.
Fellows Gear Shaper Co., Springfield, Vt.
Gleason Tool Co., Rochester, N. Y.
Gould & Eberhardt, Newark, N. J.
Grant Gear Works, Boston, Mass.
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Horsburgh & Scott Co., The, Cleveland, O.
Messmer Mfg. Co., Ferd., St. Louis, Mo.
New Process Raw Hide Co., Syracuse, N. Y.
Nuttall Co., R. D., Pittsburgh, Pa.
Patterson, Gottfried & Hunter, Ltd., New York.
Philadelphia Gear Works, Philadelphia, Pa.
Sawyer Gear Wks., Cleveland, O.
Simonds Mfg. Co., Pittsburgh, Pa.

Gears, Molded
Caldwell & Son Co., H. W., Chicago, Ill.
Franklin Mfg. Co., Syracuse, N. Y.
Greenwald Co., I. & E., Cincin., O.

Gears, Rawhide
Chicago Raw Hide Co., Chicago, Ill.
Fawcus Mch. Co., Pittsburgh, Pa.
Horsburgh & Scott Co., Cleveland, Ohio.
New Process Raw Hide Co., Syracuse, N. Y.
Nuttall Co., R. D., Pittsburgh, Pa.

Gears, Worm
Albro-Clem Elevator Co., Philadelphia, Pa.
Fawcus Mach. Co., Pittsburgh, Pa.
Morse, Williams & Co., Phila., Pa.
Nuttall Co., R. D., Pittsburgh, Pa.
Simonds Mfg. Co., Pittsburgh, Pa.

Graphite
Dixon Crucible Co., Jos., Jersey City, N. J.
Lubriphite Co., Jersey City, N. J.
Obermayer Co., S., Cincinnati, O.

Grinders, Center
Heald & Son, L. S., Barre, Mass.
Hisey-Wolf Mach. Co., Cincin., O.

Grinders, Cock
Windsor Mach. Co., Windsor, Vt.

Grinders, Cutter
Adams Co., Dubuque, Iowa.
Automatic Mach. Co., Greenfield, Mass.
Becker-Brainard Milling Mach. Co., Hyde Park, Mass.
Brown & Sharpe Mfg. Co., Providence, R. I.
Cincinnati Milling Mach. Co., Cincinnati, O.
Garvin Machine Co., New York.
Norton Emery Wheel Co., Worcester, Mass.
Pratt & Whitney Co., Hartford, Conn.
Rivett-Dock Co., Boston, Mass.
Woodward & Rogers Co., Hartford, Conn.

Grinders, Disc
Besly & Co., Chas. H., Chicago, Ill.
Gorton Mach. Co., Geo., Racine Wis.
Iroquois Mach. Co., New York.
Ransom Mfg. Co., Oshkosh, Wis.

Grinders, Drill
Gorton Mach. Co., Geo., Racine, Wis.
Heald & Son, L. S., Barre, Mass.
Standard Tool Co., Cleveland, O.
Washburn Shops, Worcester, Mass.
Wilmarth & Morman Co., Grand Rapids, Mich.

Grinders, Tool
Barnes Co., B. F., Rockford, Ill.
Barnes Co., W. F. & John, Rockford, Ill.
Barr, H. G., Worcester, Mass.
Brown & Sharpe Mfg. Co., Providence, R. I.
Diamond Mach. Co., Provi., R. I.
Gisholt Mach. Co., Madison, Wis.
Landis Tool Co., Waynesboro, Pa.
Modern Tool Co., Erie, Pa.
Northampton Emery Wheel Co., Leeds, Mass.
Ransom Mfg. Co., Oshkosh, Wis.
Safety Emery Wheel Co., Springfield, O.
Throop Perforating Co., Buffalo, N. Y.
Whitney Mfg. Co., Hartford, Ct.

Grinding Machines
Brown & Sharpe Mfg. Co., Providence, R. I.
Builders' Iron Foundry, Providence, R. I.
Diamond Mach. Co., Prov., R. I.
Falkenau-Sinclair Co., Phila., Pa.
Goodell-Pratt Co., Greenfield, Mass.
Gorton Mach. Co., Geo., Racine, Wis.
Greenfield Mach. Co., Greenfield, Mass.
Hill, Clarke & Co., Boston, Mass.
Hisey-Wolf Mch. Co., Cincin., O.
Iroquois Mach. Co., New York.
Landis Tool Co., Waynesboro, Pa.
Marshall & Huschart Mchry. Co., Chicago, Ill.
Mechanical Appliance Co., Milwaukee, Wis.
Northampton Emery Wheel Co., Leeds, Mass.
Norton Emery Wheel Co., Worcester, Mass.
Norton Grinding Co., Worcester, Mass.
Prentiss Tool & Supply Co., New York.
Ransom Mfg. Co., Oshkosh, Wis.
Safety Emery Wheel Co., Springfield, Ohio.
Throop Perforating Co., Buffalo, N. Y.
Vitrified Wheel Co., Westfield, Mass.
Washburn Shops, Worcester, Mass.
Wilmarth & Morman Co., Grand Rapids, Mich.
Woodward & Rogers Co., Hartford, Conn.

Grinding Wheels
Builders' Iron Foundry, Providence, R. I.
Carborundum Co., Niagara Falls, N. Y.
Diamond Mach. Co., Provi., R. I.
Hampden Cor. Wheel Co., Brightwood, Mass.
Northampton Emery Wheel Co., Leeds, Mass.
Norton Emery Wheel Co., Worcester, Mass.
Safety Emery Wheel Co., Springfield, O.
Vitrified Wheel Co., Westfield, Mass.
Whitney Mfg. Co., Hartford, Conn.

Grindstone Frames
Standard Tool Co., Athol, Mass.

Gun Barrel Machinery
Bement, Miles & Co., New York.
Diamond Mach. Co., Provi., R. I.
Niles Tool Works Co., New York.
Pond Mach. Tool Co., New York.
Reed Co., F. E., Worcester, Mass.

Hack Saw Blades and Frames
Diamond Saw & Stamping Wks., Buffalo, N. Y.
Goodell-Pratt Co., Greenfield, Mass.
Hammacher, Schlemmer & Co., New York.
Millers Falls Co., New York.
Patterson, Gottfried & Hunter, Ltd., New York.
Starrett Co., L. S., Athol, Mass.
West Haven Mfg. Co., New Haven, Conn.

Hack Saws, Power
Diamond Saw & Stamping Wks., Buffalo, N. Y.
Hoefer Mfg. Co., Freeport, Ill.
Millers Falls Co., New York.
West Haven Mfg. Co., New Haven, Conn.

Hammers, Drop
Bement, Miles & Co., New York.
Billings & Spencer Co., Hartford, Conn.
Bliss Co., E. W., Brooklyn, N. Y.
Miner & Peck Mfg. Co., New Haven, Conn.
Mossberg & Granville Mfg. Co., Providence, R. I.
Perkins Mach. Co., Boston, Mass.

Hammers, Pneumatic
Chicago Pneumatic Tool Co., Chicago, Ill.
Cleveland Pneumatic Tool Co., Cleveland, O.
Dallett & Co., Thos. H., Phila., Pa.
Ingersoll-Sergeant Drill Co., New York.
Phila. Pneu. Tool Co., Philadelphia, Pa.
Railway Appliances Co., Chicago, Ill.
Rand Drill Co., New York.
Standard Ry. Equip. Co., St. Louis, Mo.
Steel Roll Mangle Co., Chicago, Ill.

Hammers, Power
Scranton & Co., The, New Haven, Conn.

Hammers, Steam
Bement, Miles & Co., New York.
Bethlehem Fdry. & Mach. Co., So. Bethlehem, Pa.
Chambersburg Engr. Co., Chambersburg, Pa.
Cleveland Punch & Shear Wks. Co., Cleveland, O.
Pittsburgh Shear Knife & Mach. Co., Pittsburg, Pa.

Heating and Ventilating Apparatus
Buffalo Forge Co., Buffalo, N. Y.

Heating Machines, Automatic
Am. Gas Furnace Co., New York.

Hoisting and Conveying Machinery
Brown Hoisting Mchry. Co., New York.
Caldwell & Son Co., H. W., Chicago, Ill.
Eastern Mchry. Co., New Haven, Conn.
Hunt Co., C. W., West New Brighton, N. Y.
Link Belt Engineering Co., Philadelphia, Pa.
Niles-Bement-Pond Co., New York.

Hoists, Electric
C & C Electric Co., New York.
Hunt Co., C. W., West New Brighton, N. Y.
Northern Engineering Works, Detroit, Mich.
Pawling & Harnischfeger, Milwaukee, Wis.
Sprague Electric Co., New York.

Hoists, Hand
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Yale & Towne Mfg. Co., New York.

Hoists, Pneumatic
Chicago Pneumatic Tool Co., Chicago, Ill.
Cleveland Pneumatic Tool Co., Cleveland, O.
Curtis & Co. Mfg. Co., St. Louis, Mo.
Northern Engineering Wks., Detroit, Mich.
Rand Drill Co., New York.

Igniters, Gas Engine
Dayton Electrical Mfg. Co., Dayton, O.

Indicators, Speed
Starrett Co., L. S., Athol, Mass.

Indicators, Steam
Crosby Steam Gage & Valve Co., Boston, Mass.

Injectors
Lunkenheimer Co., Cincinnati, O.
Sellers & Co., Wm., Phila., Pa.

Inspection and Tests
Hunt Co., Robt. W., Chicago, Ill.

Instruction Schools
See Schools, Correspondence.

Insurance, Boiler
Hartford Steam Boiler Insp. & Ins. Co., Hartford, Conn.

Jacks, Hydraulic
Bethlehem Fdry. & Mch. Co., So. Bethlehem, Pa.
Watson-Stillman Co., New York.

Jack Planer
Armstrong Bros. Tool Co., Chicago, Ill.

Key Seaters
Baker Bros., Toledo, O.
Bement, Miles & Co., New York.
Chattanooga Mchry. Co., Chattanooga, Tenn.
Davis Mach. Co., W. P., Rochester, N. Y.
Mitts & Merrill, Saginaw, Mich.
Whitney Mfg. Co., Hartford, Conn.

Keys, Machine
Standard Gauge Steel Co., Beaver Falls, Pa.
Whitney Mfg. Co., Hartford, Ct.

Knives, Solid Steel Shear
Pittsburg Shear Knife & Mach. Co., Pittsburg, Pa.

Lamps, Arc
General Electric Co., N. Y. City.
Western Electric Co., Chicago, Ill.
Westinghouse Elec. & Mfg. Co., Pittsburgh, Pa.

Lathe Attachments
National Machine Tool Co., Cincinnati, O.

Lathe Dogs
Armstrong Bros. Tool Co., Chicago, Ill.
Besly & Co., Chas. H., Chicago, Ill.
Hill Tool Co., Anderson, Ind.
Le Count, Wm. G., So. Norwalk, Conn.
Pratt & Whitney Co., Hartford, Conn.
Tindel-Morris Co., Eddystone, Pa.

Lathes
Affleck, Geo. E., New York.
American Tool Wks. Co., Cin., O.
Automatic Mach. Co., Greenfield, Mass.
Barker & Co., Wm., Cincinnati, O.
Barnes Co., B. F., Rockford, Ill.
Barnes Co., W. F. & John, Rockford, Ill.
Bement, Miles & Co., New York.
Blaisdell & Co., P., Worcester, Mass.

Lathes—*Continued*
Bradford Mach. Tool Co., Cin., O.
Brown & Zortman Mchry. Co., Pittsburg, Pa.
Bullard Mach. Tool Co., Bridgeport, Conn.
Davis Mach. Co., W. P., Rochester, N. Y.
Diamond Machine Co., Prov., R. I.
Draper Mach. Tool Co., Worcester, Mass.
Fay & Scott, Dexter, Me.
Flather & Co., Nashua, N. H.
Garvin Mach. Co., New York.
Greaves, Klusman Co., Cincin., O.
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Hendey Mach. Co., Torrington, Ct.
Hill, Clarke & Co., Boston, Mass.
Le Blond Mach. Tool Co., R. K., Cincinnati, O.
Lodge & Shipley Mch. Tool Co., Cincinnati, O.
McCabe, J. J., New York.
Marshall & Huschart Mchry. Co., Chicago, Ill.
Milwaukee Machine Tool Co., Milwaukee, Wis.
New Haven Mfg. Co., New Haven, Conn.
Niles Tool Works Co., New York.
Pond Mach. Tool Co., New York.
Pratt & Whitney Co., Hartford, Conn.
Prentiss Tool & Supply Co., New York.
Reed Co., F. E., Worcester, Mass.
Schumacher & Boye, Cincinnati, Ohio.
Sebastian Lathe Co., Cincin., O.
Seneca Falls Mfg. Co., Seneca Falls, N. Y.
Shepard Lathe Co., Cincinnati., O.
Washburn Shops, Worcester, Mass.

Lathes, Automatic Screw-Threading
Automatic Machine Co., Bridgeport, Conn.

Lathes, Bench
Faneuil Watch Tool Co., Boston, Mass.
Hardinge Bros., Chicago, Ill.
Loop-Lock Mach. Co., Waltham, Mass.
Waltham Watch Tool Co., Springfield, Mass.

Lathes, Boring
Streit Mach. Co., A., Cincin., O.

Letters, Pattern
Brim, A. W., Seneca Falls, N. Y.
Butler, A. G., N. Y. City.

Levels
Davis & Cook, Watertown, N. Y.
Mass. Tool Co., Greenfield, Mass.
Starrett Co., L. S., Athol, Mass.

Lockers, Clothes
Merritt & Co., Philadelphia, Pa.
Narragansett Mach. Co., Providence, R. I.

Locomotives, Shop
Hunt Co., C. W., West New Brighton, N. Y.

Lubricants
Besly & Co., Chas. H., Chicago, Ill.
Dixon Crucible Co., Jos., Jersey City, N. J.
Lubriphite Co., Jersey City, N. J.

Lubricators
Besly & Co., Chas. H., Chicago, Ill.
Bowen Mfg. Co., Auburn, N. Y.
Crane Co., Chicago, Ill.
Lubriphite Co., Jersey City, N. J.
Lunkenheimer Co., Cincinnati, O.

Machine Screws
Atlantic Mach. Screw Co., Boston, Mass.
Worcester Mach. Screw Co., Worcester, Mass.

Machinery Builders, Special
American Fdry. & Mach. Co., Hanover, Pa.
Blanchard Mach. Co., The, Boston, Mass.
Eclipse Mach. Co., Cleveland, O.
Faweus Mch. Co., Pittsburgh, Pa.
Hart, Fredk., Poughkeepsie, N. Y.
Hoefer Mfg. Co., Freeport, Ill.
Pratt & Whitney Co., Hartford, Conn.
Rhodes, L. E., Hartford, Conn.
Simonds Mfg. Co., Pittsburgh, Pa.
Wade Mach. Works, Walter H., Boston, Mass.
Woodward & Rogers Co., Hartford, Conn.

Machinists' Small Tools
Besly & Co., Chas. H., Chicago, Ill.
Billings & Spencer Co., Hartford, Conn.
Brown & Sharpe Mfg. Co., Providence, R. I.
Cleveland Twist Drill Co., Cleveland, O.
Davis & Cook, Watertown, N. Y.
Hammacher, Schlemmer & Co., New York.
McCrosky, F. B., Cincinnati, O.
Mass. Tool Co., Greenfield, Mass.
Patterson, Gottfried & Hunter, Ltd., New York.
Sawyer Tool Mfg. Co., Fitchburg, Mass.
Slocomb Co., J. T., Provi., R. I.
Standard Tool Co., Athol, Mass.
Standard Tool Co., Cleveland, O.
Starrett Co., L. S., Athol, Mass.

Machinists' Supplies
Hammacher, Schlemmer & Co., New York.
Patterson, Gottfried & Hunter, Ltd., New York.

Mandrels, Expanding
Nicholson & Son, W. H., Wilkesbarre, Pa.

Mandrels, Solid
Cleveland Twist Drill Co., Cleveland, O.
Morse Twist Drill & Mach. Co., New Bedford, Mass.
Rogers, John M., Boat, Gage & Drill Works, Gloucester City, N. J.
Standard Tool Co., Cleveland, O.

Measuring Machines
Rogers, John M., Boat, Gage & Drill Works, Gloucester City, N. J.

Metal, Bearing
Besly & Co., Chas. H., Chicago, Ill.
Patterson, Gottfried & Hunter, Ltd., New York.
Phosphor Bronze Smelting Co., Philadelphia, Pa.

Metal, Perforated
Throop Perforating Co., Buffalo, N. Y.

Micrometer Calipers
Brown & Sharpe Mfg. Co., Providence, R. I.
Sawyer Tool Mfg. Co., Fitchburg, Mass.
Slocomb Co., J. T., Providence, R. I.
Starrett Co., L. S., Athol, Mass.

Milling Attachments
The Adams Co., Dubuque, Iowa.
Becker-Brainard Milling Mach. Co., Hyde Park, Mass.
Brown & Sharpe Mfg. Co., Providence, R. I.
Cincinnati Milling Mach. Co., Cincinnati, O.
Whitney Mfg. Co., Hartford, Conn.

Milling Machines, Bench
Faneuil Watch Tool Co., Boston, Mass.
Hill, Clarke & Co., Boston, Mass.
Loop-Lock Mach. Co., Waltham, Mass.
Waltham Watch Tool Co., Springfield, Mass.

Milling Machines, Portable
Underwood & Co., H. B., Philadelphia, Pa.

Milling Machines, Plain
American Tool Wks. Co., Cin., O.
Aurora Tool Works, Aurora, Ind.
Becker-Brainard Milling Mach. Co., Hyde Park, Mass.
Bement, Miles & Co., New York.
Brown & Sharpe Mfg. Co., Providence, R. I.
Cincinnati Milling Mach. Co., Cincinnati, O.
Garvin Mach. Co., New York.
Hendey Mach. Co., Torrington, Ct.
Hill, Clarke & Co., Boston, Mass.
Kempsmith Mfg. Co., Milwaukee, Wis.
Le Blond Mach. Tool Co., R. K., Cincinnati, O.
Marshall & Huschart Mchry. Co., Chicago, Ill.
McCabe, J. J., New York.
Owen Mach. Tool Co., Springfield, Ohio.
Prentiss Tool & Supply Co., New York.
Whitney Mfg. Co., Hartford, Ct.

Milling Machines, Horizontal

Adams Co., Dubuque, Iowa.
Beaman & Smith Co., Prov., R. I.
Becker-Brainard Milling Mach. Co., Hyde Park, Mass.
Bement, Miles & Co., New York.
Hendey Mach. Co., Torrington, Ct.
Ingersoll Mill. Mach. Co., Rockford, Ill.
Newton Mach. Tool Wks., Philadelphia, Pa.
Niles Tool Works Co., New York.
Pratt & Whitney Co., Hartford, Conn.

Milling Machines, Universal

American Tool Wks. Co., Cin., O.
Aurora Tool Works, Aurora, Ind.
Becker-Brainard Milling Mach. Co., Hyde Park, Mass.
Bement, Miles & Co., New York.
Brown & Sharpe Mfg. Co., Providence, R. I.
Cincinnati Milling Mach. Co., Cincinnati, O.
Garvin Mach. Co., New York.
Hendey Mach. Co., Torrington, Ct.
Hill, Clarke & Co., Boston, Mass.
Kempsmith Mfg. Co., Milwaukee, Wis.
Le Blond Mach. Tool Co., R. K., Cincinnati, O.
Marshall & Huschart Mchry. Co., Chicago, Ill.
McCabe, J. J., New York.
Niles Tool Works Co., New York.
Owen Mach. Tool Co., Springfield, Ohio.
Prentiss Tool & Supply Co., New York.
Waltham Watch Tool Co., Springfield, Mass.

Milling Machines, Vertical

Becker-Brainard Milling Mach. Co., Hyde Park, Mass.
Bement, Miles & Co., New York.
Brown & Sharpe Mfg. Co., Providence, R. I.
Garvin Mach. Co., New York.
Ingersoll Mill. Mach. Co., Rockford, Ill.
Newton Mch. Tool Works, Philadelphia, Pa.
Niles Tool Works Co., New York.
Owen Mach. Tool Co., Springfield, Ohio.
Pratt & Whitney Co., Hartford, Conn.
Quint, A. D., Hartford, Conn.

Milling Tools, Adjustable

Geometric Drill Co., New Haven, Conn.
Rogers, Boat, Gage & Drill Wks., John M., Gloucester City, N. J.

Molding Machines

Adams Co., The, Dubuque, Iowa.
American Foundry & Mach. Co., Hanover, Pa.
Tabor Mfg. Co., Philadelphia, Pa.

Motors, Electric

C & C Electric Co., New York.
Christensen Engr. Co., Milwaukee, Wis.
Commercial Electric Co., Indianapolis, Ind.
Crocker-Wheeler Co., Ampere, N.J.
Eck Dynamo & Motor Wks., Belleville, N. J.
General Electric Co., New York.
Jantz & Leist Elec. Co., Cin., O.
Mechanical Appliance Co., Milwaukee, Wis.
Milwaukee Elec. Co., Milwaukee, Wis.
Northern Elec. Mfg. Co., Madison, Wis.
Robbins & Myers Co., Springfield, Ohio.
Roth Bros. & Co., Chicago, Ill.
Sprague Electric Co., New York.
Storey Motor & Electric Co., Harrison, N. J.
Triumph Elec. Co., Cincinnati, O.
Western Electric Co., Chicago, Ill.
Westinghouse Elec. & Mfg. Co., Pittsburgh, Pa.

Name Plates

Franklin Mfg. Co., Syracuse, N. Y.
G. & P. Engraving Co., Boston, Mass.
Murdock Corporation, Boston, Mass.
Turner Brass Works, Chicago, Ill.

Nut Tappers

See Bolt and Nut Machinery.

Oils

Besly & Co., Chas. H., Chicago, Ill.
Harris Oil Co., A. W., Provl., R. I.

Oils, Slushing

Harris Oil Co., A. W., Provl., R. I.

Oil Cups and Covers

Bay State Stamping Works, Worcester, Mass.
Besly & Co., Chas. H., Chicago, Ill.
Bowen Mfg. Co., Auburn, N. Y.
Bown Machine Works, Battle Creek, Mich.
Crane Co., Chicago, Ill.
Lunkenheimer Co., Cincinnati, O.
Tucker, W. W. & C. F., Hartford, Conn.
The Winkley Co., Hartford, Conn.

Oil Stones

Pike Mfg. Co., Pike Station, N. H.

Packing, Steam Joint

Jenkins Bros., New York.
N. Y. Belting & Packing Co., New York.
Peerless Rubber Mfg. Co., New York.

Paint, Machinery

Felton, Sibley & Co., Phila., Pa.

Pans, Lathe

New Britain Mch. Co., New Britain, Conn.

Patents

Baldwin, Davidson & Wight, Washington, D. C.
Frothingham, N. L., New York.
Straley, Hasbrouck & Schloeder, New York.

Pattern Shop Machinery

American Mchry. Co., Grand Rapids, Mich.
Baker Bros., Toledo, O.
Brown & Zortman Mchry. Co., Pittsburg, Pa.
Fay & Scott, Dexter, Me.
Greaves, Klusman & Co., Cin., O.
Prentiss Tool & Supply Co., New York.
Washburn Shops, Worcester, Mass.

Pencils

Keuffel & Esser Co., New York.

Phosphor Bronze

Phosphor Bronze Smelting Co., Philadelphia, Pa.

Pinion Cutters

Loop-Lock Mach. Co., Waltham, Mass.

Pipe and Fittings

Crane Co., Chicago, Ill.

Pipe Cutting and Threading Machines

Bignall & Keeler Mfg. Co., Edwardsville, Ill.
Curtis & Curtis Co., Bridgeport, Conn.
Merrell Mfg. Co., Toledo, O.
Reed Mfg. Co., Erie, Pa.
Saunders' Sons, D., Yonkers, N. Y.
Wells Bros. Co., Greenfield, Mass.

Pipe Fitters' Tools

Cleveland Twist Drill Co., Cleveland, O.
Saunders' Sons, D., Yonkers, N. Y.
Standard Tool Co., Cleveland, O.

Planers

Affleck, Geo. E., New York.
American Tool Wks. Co., Cin., O.
Belmer Mach. Tool Co., Cin., O.
Bement, Miles & Co., New York.
Betts Mach. Co., Wilmington, Del.
Cincinnati Planer Co., Cincin., O.
Detrick & Harvey Mch. Co., Baltimore, Md.
Fairbanks Co., New York.
Flather Planer Co., Mark, Nashua, N. H.
Garvin Mach. Co., New York.
Gray Co., G. A., Cincinnati, O.
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Hendey Mach. Co., Torrington, Ct.
Hill, Clarke & Co., Boston, Mass.
McCabe, J. J., New York.
Niles Tool Works Co., New York.
New Haven Mfg. Co., New Haven, Conn.
Pond Mach. Tool Co., New York.
Prentiss Tool & Supply Co., New York.
Sellers & Co., Wm., Phila., Pa.
Whitcomb Mfg. Co., Worcester, Mass.
Woodward & Powell Planer Co., Worcester, Mass.

Planers, Portable

Morton Mfg. Co., Muskegon Heights, Mich.
Underwood & Co., H. B., Philadelphia, Pa.

Planers, Rotary

Bement, Miles & Co., New York.
Cleveland Punch & Shear Works, Cleveland, O.
Newton Mach. Tool Wks., Philadelphia, Pa.
Pond Mach. Tool Co., New York.
Underwood & Co., H. B., Philadelphia, Pa.

Presses, Hand

Elmes Engr. Wks., Chas. F., Chicago, Ill.
Perkins Mach. Co., So. Boston, Mass.

Presses, Hydraulic

Elmes Engr. Wks. Chas. F., Chicago, Ill.
Watson-Stillman Co., New York.

Presses, Power

Automatic Mach. Co., Bridgeport, Conn.
Bethlehem Fdry. & Mch. Co., So. Bethlehem, Pa.
Bliss Co., E. W., Brooklyn, N. Y.
Chambersburg Engr. Co., Chambersburg, Pa.
Mossberg & Granville Mfg. Co., Providence, R. I.
Perkins Mach. Co., So. Boston, Mass.
Prentiss Tool & Supply Co., New York.

Profilers

Garvin Mach. Co., New York.
Pratt & Whitney Co., Hartford, Conn.

Pulleys

American Pulley Co., Phila., Pa.
Caldwell & Son Co., H. W., Chicago, Ill.
Cresson Co., Geo. V., Phila., Pa.
Federal Mfg. Co., Cleveland, O.
Howard Iron Wks., Buffalo, N. Y.
Oneida Steel Pulley Co., Oneida, N. Y.
Patterson, Gottfried & Hunter, Ltd., New York.
Reeves Pulley Co., Columbus, Ind.
The Xylotite Co., Cincinnati, O.

Pulleys, Friction Cone

Evans Friction Cone Co., Boston, Mass.

Pulleys, Speed Changing

Speed Changing Pulley Co., Indianapolis, Ind.

Pulley Turning and Boring Machines

Harrington, Son & Co., Edwin, Philadelphia, Pa.
New Haven Mfg. Co., New Haven, Conn.
Niles Tool Works Co., New York.
Streit Mach. Co., A., Cincin., O.

Pumps, Hydraulic

Elmes Engr. Wks., Chas. F., Chicago, Ill.
Watson-Stillman Co., New York.

Punches, Hydraulic

Bement, Miles & Co., New York.
Bethlehem Fdry. & Mch. Co., So. Bethlehem, Pa.
Watson-Stillman Co., New York.

Punches, Power

Bliss Co., E. W., Brooklyn, N. Y.
Bremer Mach. & Tool Co., Kalamazoo, Mich.
Buffalo Forge Co., Buffalo, N. Y.
Cincinnati Punch & Shear Co., Cincinnati, O.
Cleveland Punch & Shear Wks. Co., Cleveland, O.
Hilles & Jones Co., Wilmington, Del.
Long & Allstatter Co., Hamilton, Ohio.
Perkins Mach. Co., S. Boston, Mass.

Rack Cutting Machines

Fellows Gear Shaper Co., Springfield, Vt.
Le Blond Mach. Tool Co., R. K., Cincinnati, O.
Reed Co., F. E., Worcester, Mass.

Racks, Cut

Fellows Gear Shaper Co., Springfield, Vt.
Nuttall Co., R. D., Pittsburgh, Pa.
Simonds Mfg. Co., Pittsburgh, Pa.
Standard Gauge Steel Co., Beaver Falls, Pa.

Racks, Tool

New Britain Mach. Co., New Britain, Conn.

Reamers

Chadwick & Co., G. B., Portsmouth, N. H.
Cleveland Twist Drill Co., Cleveland, O.
Clough, R. M., Tolland, Conn.
McCrosky, F. B., Cincinnati, O.
Morse Twist Drill & Mach. Co., New Bedford, Mass.
New Process Twist Drill Co., Taunton, Mass.
Pratt & Whitney Co., Hartford, Conn.
Rogers, John M., Boat, Gage & Drill Works, Gloucester City, N. J.
Standard Tool Co., Cleveland, O.
Wells Bros. Co., Greenfield, Mass.

Reaming Stands

Flather Planer Co., Mark, Nashua, N. H.

Rheostats

Cutler-Hammer Mfg. Co., Milwaukee, Wis.

Riveters, Pneumatic

Bement, Miles & Co., New York.
Cleveland Pneumatic Tool Co., Cleveland, O.
Philadelphia Pneumatic Tool Co., Philadelphia, Pa.
Railway Appliances Co., Chicago, Ill.
Rand Drill Co., New York.
Standard Ry. Equip. Co., St. Louis, Mo.

Riveters, Hydraulic

Bement, Miles & Co., New York.
Watson-Stillman Co., New York.

Riveting Machines

Bement, Miles & Co., New York.
Bethlehem Foundry & Mach. Co., So. Bethlehem, Pa.
Chambersburg Engr. Co., Chambersburg, Pa.
Long & Allstatter Co., Hamilton, Ohio.
Perkins Mach. Co., So. Boston, Mass.

Roller and Ball Bearings

American Roller Bearing Co., Boston, Mass.
Ball Bearing Co., Philadel., Pa.
Bantam Mfg. Co., Bantam, Conn.
Mossberg & Granville Mfg. Co., Providence, R. I.

Rolling Mill Machinery

Cleveland Punch & Shear Wks. Co., Cleveland, O.
Hilles & Jones Co., Wilmington, Del.
Mossberg & Granville Mfg. Co., Providence, R. I.
Pratt & Whitney Co., Hartford, Conn.

Rubber Goods, Mechanical

N. Y. Belting & Packing Co., New York.
Peerless Rubber Mfg. Co., New York.

Rules, Steel

Mass. Tool Co., Greenfield, Mass.
Sawyer Tool Co., Fitchburg, Mass.
Slocomb Co., J. T., Provl., R. I.

Safety Valves, Pop

Crane Co., Chicago, Ill.
Crosby Steam Gage & Valve Co., Boston, Mass.
Lunkenheimer Co., Cincinnati, O.

Sand Blast Apparatus

Paxson Co., J. W., Philadel., Pa.

Sand Mixing Machines

Smith Fdry. Supply Co., J. D., Cleveland, O.
Hanna, E. E., Chicago, Ill.
Obermayer Co., S., Cincinnati, O.

Sawing Machines, Metal

Cleveland Punch & Shear Works Co., Cleveland, O.
Cochrane-Bly Mach. Works, Rochester, N. Y.
Newton Mach. Tool Works, Philadelphia, Pa.
Pratt & Whitney Co., Hartford, Conn.
West Haven Mfg. Co., New Haven, Conn.

Sawing Machines, Wood

Brown & Zortman Mchry. Co., Pittsburg, Pa.

Schools, Correspondence

Amer. School of Correspondence, Chicago, Ill.
Consolidated Schools, N. Y. City.
International Correspond. Schools, Scranton, Pa.

Schools, Technical
Mich. College of Mines, Houghton, Mich.
Rose Polytechnic Institute, Terre Haute, Ind.
State College of Ky., Lexington, Ky.

Screw Machines, Automatic
Brown & Sharpe Mfg. Co., Providence, R. I.
Cleveland Automatic Mach. Co., Cleveland, O.
Dreses Mach. Tool Co., Cincin., O.
Marshall & Huschart Mchry. Co., Chicago, Ill.
Windsor Mach. Co., Windsor, Vt.

Screw Machines, Hand
Brown & Sharpe Mfg. Co., Providence, R. I.
Cleveland Automatic Mach. Co., Cleveland, O.
Draper Mach. Tool Co., Worcester, Mass.
Garvin Mach. Co., New York.
Jones & Lamson Mch. Co., Springfield, Vt.
Pearson Mach. Co., Chicago, Ill.
Potter & Johnston Mach. Co., Pawtucket, R. I.
Pratt & Whitney Co., Hartford, Conn.
Warner & Swasey Co., Cleveland, Ohio.
Windsor Mach. Co., Windsor, Vt.

Screw Machinery, Wood and Lag
Baker Bros., Toledo, Ohio.
Cook Co., Asa S., Hartford, Conn.

Screw Plates
Bay State Tap & Die Co., Mansfield, Mass.
Besly & Co., Chas. H., Chicago, Ill.
Carpenter Tap & Die Co., J. M., Pawtucket, R. I.
Card Mfg. Co., S. W., Mansfield, Mass.
Hart Mfg. Co., Cleveland, O.
Morse Twist Drill & Mach. Co., New Bedford, Mass.
Wells Bros. Co., Greenfield, Mass.

Second Hand Machinery
Ailleck, Geo. E., New York.
Baird Machy. Co., Pittsburg, Pa.
Bennett, Geo. L., New York.
Bowler & Co., Geo. H., Cleveland, Ohio.
Brown & Zortman Mchry. Co., Pittsburgh, Pa.
Carlin Mchry. & Supply Co., Allegheny, Pa.
Fairbanks Co., Philadelphia, Pa.
Garvin Mch. Co., New York.
Hill, Clarke & Co., Boston, Mass.
Marshall & Huschart Mchry. Co., Chicago, Ill.
McCabe, J. J., New York.
Niles-Bement-Pond Co. New York.
Packard Machinery Co., O. L., Chicago, Ill.
Pratt & Whitney Co., Hartford, Conn.
Prentiss Tool & Supply Co., New York.
Toomey, Frank, Philadelphia, Pa.
Wickes Bros., New York.
Wormer Machy. Co., C. C., Detroit, Mich.

Separators, Magnetic
Sawyer, Ezra, Worcester, Mass.

Separators, Oil
National Separator & Mch. Co., Manchester, N. H.

Shapers
American Tool Wks. Co., Cin., O.
Barker & Co., Wm., Cincinnati, O.
Bement, Miles & Co., New York.
Cincinnati Shaper Co., Cincin., O.
Flather Planer Co., Mark, Nashua, N. H.
Garvin Mach. Co., New York.
Gould & Eberhardt, Newark, N. J.
Hendey Mch. Co., Torrington, Ct.
Hill, Clarke & Co., Boston, Mass.
Kelly Co., R. A., Xenia, Ohio.
Marshall & Huschart Mchry. Co., Chicago, Ill.
Morton Mfg. Co., Muskegon Heights, Mich.
New Haven Mfg. Co., New Haven, Conn.
Niles Tool Works Co., New York.
Perkins Mach. Co., So. Boston, Mass.
Potter & Johnston Mach. Co., Pawtucket, R. I.
Prentiss Tool & Supply Co., New York.
Smith & Mills, Cincinnati, O.
Steptoe Shaper Co., John, Cincinnati, O.

Shears, Power
Bethlehem Fdry. & Mch. Co., So. Bethlehem, Pa.
Bliss Co., E. W., Brooklyn, N. Y.
Bremer Mach. & Tool Co., Kalamazoo, Mich.
Buffalo Forge Co., Buffalo, N. Y.
Cincinnati Punch & Shear Co., Cincinnati, O.
Cleveland Punch & Shear Works, Cleveland, O.
Hilles & Jones Co., Wilmington, Del.
Long & Allstatter Co., Hamilton, Ohio.
Perkins Mach. Co., So. Boston, Mass.

Shears, Rotary
Bethlehem Foundry & Mach. Co., So. Bethlehem, Pa.
Detrick & Harvey Mach. Co., Baltimore, Md.
Perkins Mach. Co., So. Boston, Mass.

Shelving, Shop
New Britain Mach. Co., New Britain, Conn.

Slide Rests
Reed Co., F. E., Worcester, Mass.
Rhodes, F. E., Hartford, Conn.

Slotters
Baker Bros., Toledo, Ohio.
Barr, H. G., Worcester, Mass.
Bement, Miles & Co., New York.
Betts Mach. Co., Wilmington, Del.
Garvin Mach. Co., New York.
New Haven Mfg. Co., New Haven, Conn.
Newton Mach. Tool Wks., Philadelphia, Pa.
Niles Tool Works Co., New York.

Sockets and Sleeves
New Process Twist Drill Co., Taunton, Mass.

Sprocket Chains
See Driving Chains.

Stampings, Sheet Steel
Federal Mfg. Co., Cleveland, O.

Stamps, Steel
Schwerdtle Stamp Co., Bridgeport, Conn.

Steel, Machinery
Boker & Co., Hermann, New York.
Patriarche & Bell, New York.
Ward & Son, Edgar T., Boston, Mass.

Steel, Sheet
Federal Mfg. Co., Cleveland, O.
Ward & Son, Edgar T., Boston, Mass.

Steel, Tool
Boker & Co., Hermann, New York.
Firth-Sterling Steel Co., Demmler, Pa.
Patriarche & Bell, New York.
Patterson, Gottfried & Hunter, Ltd., New York.
Westmoreland Steel Co., Pittsburg, Pa.

Stones, Oil
Pike Mfg. Co., Pike Station, N. H.

Straightener, Hydraulic
Bement, Miles & Co., New York.
Watson-Stillman Co., New York.

Swaging Machines
Excelsior Needle Co., Torrington, Conn.
Mossberg & Granville Mfg. Co., Providence, R. I.

Switchboards
C & C Electric Co., New York.
Triumph Elec. Co., Cincinnati, O.
Western Electric Co., Chicago, Ill.
Westinghouse Elec. & Mfg. Co., Pittsburg, Pa.

Tapping Machines and Attachments
Baker Bros., Toledo, O.
The Beaman & Smith Co., Providence, R. I.
Bickford Drill & Tool Co., Cin., O.
Cincinnati Mach. Tool Co., Cincinnati, O.
Errington, F. A., N. Y. City.
Fosdick Mach. Tool Co., Cin., O.
Garvin Mach. Co., New York.
Geometric Drill Co., New Haven, Conn.
Modern Tool Co., Erie, Pa.

Tapping Machines and Attachments—*Continued*
Pratt & Whitney Co., Hartford, Conn.
Quint, A. D., Hartford, Conn.
Whitney Mfg. Co., Hartford, Conn.
Woodward & Rogers Co., Hartford, Conn.

Taps, Collapsing
Geometric Drill Co., New Haven, Conn.

Taps and Dies
Bay State Tap & Die Co., Mansfield, Mass.
Besly & Co., Chas. H., Chicago, Ill.
Card Mfg. Co., S. W., Mansfield, Mass.
Carpenter Tap & Die Co., J. M., Pawtucket, R. I.
Cleveland Twist Drill Co., Cleveland, O.
Crane Co., Chicago, Ill.
Geometric Drill Co., New Haven, Conn.
Hammacher, Schlemmer & Co., New York.
Hardinge Bros., Chicago, Ill.
Hart Mfg. Co., Cleveland, O.
Morse Twist Drill & Mach. Co., New Bedford, Mass.
Patterson, Gottfried & Hunter, Ltd., New York.
Pratt & Whitney Co., Hartford, Conn.
Standard Tool Co., Cleveland, O.
Wells Bros. Co., Greenfield, Mass.

Telephone System
Clark Auto. Telephone Switch Board Co., Providence, R. I.

Thread Cutting Tools
Besly & Co., Chas. H., Chicago, Ill.
Hart Mfg. Co., Cleveland, O.
Pratt & Whitney Co., Hartford, Conn.
Rivett-Dock Co., Boston, Mass.

Tool Holders
Armstrong Bros. Tool Co., Chicago, Ill.
Hill Tool Co., Anderson, Ind.
Hoggson & Pettis Mfg. Co., New Haven, Conn.
McCrosky, F. B., Cincinnati, O.
O. K. Tool Holder Co., Shelton, Conn.

Tools, Small
See Machinists' Small Tools.

Tracing Cloth
Keuffel & Esser Co., New York.
Hardtmuth, L. & C., New York.

Transmission Machinery
American Pulley Co., Phila., Pa.
Caldwell & Son Co., H. W., Chicago, Ill.
Case Mfg. Co., Columbus, O.
Cresson & Co., Geo. V., Phila., Pa.
Federal Mfg. Co., Cleveland, O.
Link-Belt Engineering Co., Philadelphia, Pa.
National Machine Tool Co., Cincinnati, O.
Oneida Steel Pulley Co., Oneida, N. Y.
Patterson, Gottfried & Hunter, Ltd., New York.
Reeves Pulley Co., Columbus, Ind.

Trimmers, Wood
American Mchry. Co., Grand Rapids, Mich.
Carlin Mchry. & Supply Co., Allegheny, Pa.
Washburn Shops, Worcester, Mass.

Trolleys and Tramways
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Hunt Co., C. W., West New Brighton, N. Y.
Link Belt Engineering Co., Philadelphia, Pa.
Maris Bros., Philadelphia, Pa.
Yale & Towne Mfg. Co., New York.

Tubing, Steel
Shelby Steel Tube Co., Pittsburgh, Pa.

Turret Machines
Automatic Mach. Co., Greenfield, Mass.
Bradford Mach. Tool Co., Cincinnati, O.
Brown & Sharpe Mfg. Co., Providence, R. I.
Bullard Mach. Tool Co., Bridgeport, Conn.
Dreses Mach. Tool Co., Cincin., O.
Flather & Co., Nashua, N. H.

Turret Machines—*Continued*
Garvin Mach. Co., New York.
Gisholt Mch. Co., Madison, Wis.
Hill, Clarke & Co., Boston, Mass.
Jones & Lamson Mch. Co., Springfield, Vt.
Le Blond Mach. Tool Co., R. K., Cincinnati, O.
Lodge & Shipley Mach. Tool Co., Cincinnati, O.
Milwaukee Mach. Tool Co., Milwaukee, Wis.
Niles Tool Works Co., New York.
Pearson Mach. Co., Chicago, Ill.
Potter & Johnston Mach. Co., Pawtucket, R. I.
Warner & Swasey Co., Cleveland, Ohio.
Windsor Mach. Co., Windsor, Vt.

Turrets, Carriage
Fay & Scott, Dexter, Me.

Twist Drills
Cleveland Twist Drill Co., Cleveland, O.
Hammacher, Schlemmer & Co., New York.
Morse Twist Drill & M. Co., New Bedford, Mass.
New Process Twist Drill Co., Taunton, Mass.
Patterson, Gottfried & Hunter, Ltd., New York.
Standard Tool Co., Cleveland, O.

Unions, Brass
Nolte Brass Co., Springfield, O.

Universal Joints
Baush Machine Tool Co., Springfield, Mass.
Gray & Prior Mch. Co., Hartford, Conn.
Vanderbeek Tool Wks., Hartford, Conn.

Valves
See Steam Fittings.

Vises, Drill
Graham Mfg. Co., Provi., R. I.
Hollands Mfg. Co., Erie, Pa.
Jacobson Mach. Mfg. Co., Warren, Pa.

Vises, Metal Workers'
Hammacher, Schlemmer & Co., New York.
Hanna, E. E., Chicago, Ill.
Howard Iron Wks., Buffalo, N. Y.
Jacobson Mach. Mfg. Co., Warren, Pa.
Parker Co., Chas., Meriden, Conn.
Reed Mfg. Co., Erie, Pa.
Standard Tool Co., Athol, Mass.
Walworth Mfg. Co., Boston, Mass.

Vises, Pipe
Curtis & Curtis Co., Bridgeport, Conn.
Saunders' Sons, D., Yonkers, N. Y.
Walworth Mfg. Co., Boston, Mass.

Vises, Planer and Shaper
Cincinnati Planer Co., Cincin., O.
Hendey Mach. Co., Torrington, Ct.
Pratt & Whitney Co., Hartford, Conn.

Vises, Wood Workers'
Hammacher, Schlemmer & Co., New York.
Wyman & Gordon, Worcester, Mass.

Welding Machines
Long & Allstatter Co., Hamilton, Ohio.

Wire-Drawing Machinery
Iroquois Mach. Co., New York.
Mossberg & Granville Mfg. Co., Providence, R. I.

Wire-Forming Machinery
Automatic Mach. Co., Bridgeport, Conn.

Wire-Straightening Machinery
Hoefer Mfg. Co., Freeport, Ill.

Worm Hobbing Machines
Pratt & Whitney Co., Hartford, Conn.

Worm Milling Machines
Cleveland Automatic Mach. Co., Cleveland, O.
Pratt & Whitney Co., Hartford, Conn.

Wrenches
Coes Wrench Co., Worcester, Mass.
Standard Tool Co., Athol, Mass.

Wrenches, Drop Forged
Billings & Spencer Co., Hartford, Conn.

Motor-Driven Shafting Lathe.

The accompanying engravings illustrate a recently designed shafting lathe which has points of interest to which we call attention.

This machine is driven by a Bullock 18 horse-power, variable-speed motor, which (which is of steel running in bronze boxes) has three times as many speeds as the motor, as it may be driven direct, through back gears, or through triple gear, the back gear being operated by the handle to the left of the head and by a sliding pinion at the opposite end of the back gear ratios are, respectively, 10.8 and 42.9 to 1. The spindle speeds range, therefore, from 4.7 to 360 turns per minute.

The lathe is provided, as will be noticed, with a footstock drive, the geared face-plate at the footstock being clearly shown in the illustrations. This driving plate is

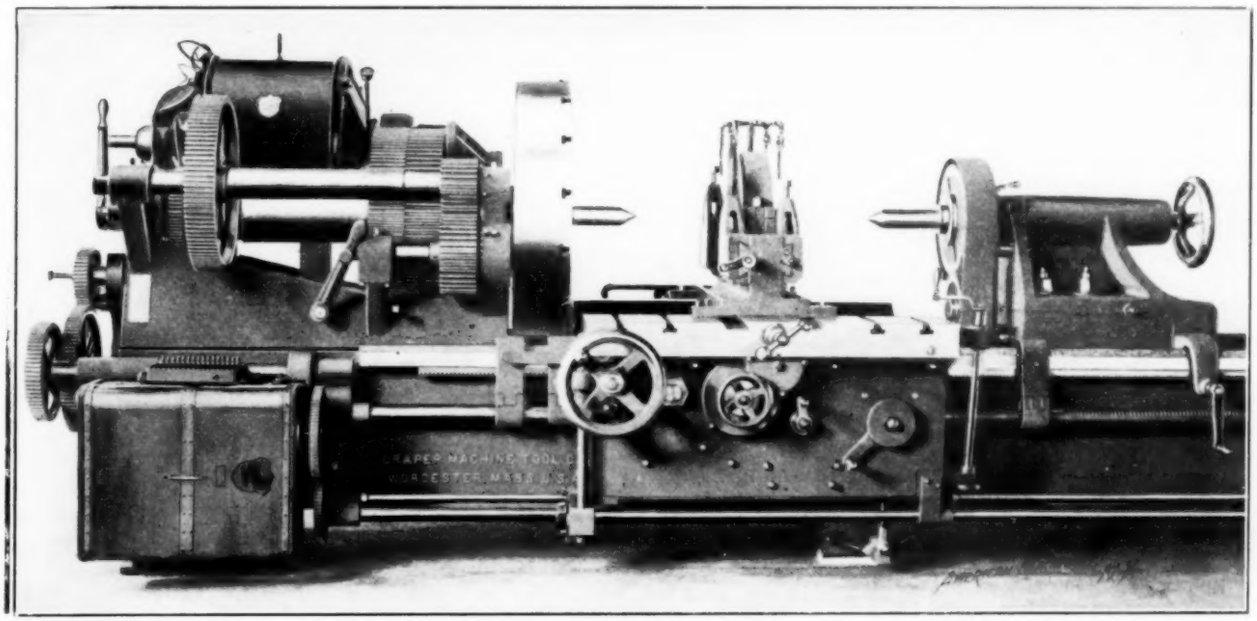


FIG. 1. MOTOR-DRIVEN SHAFTING LATHE.

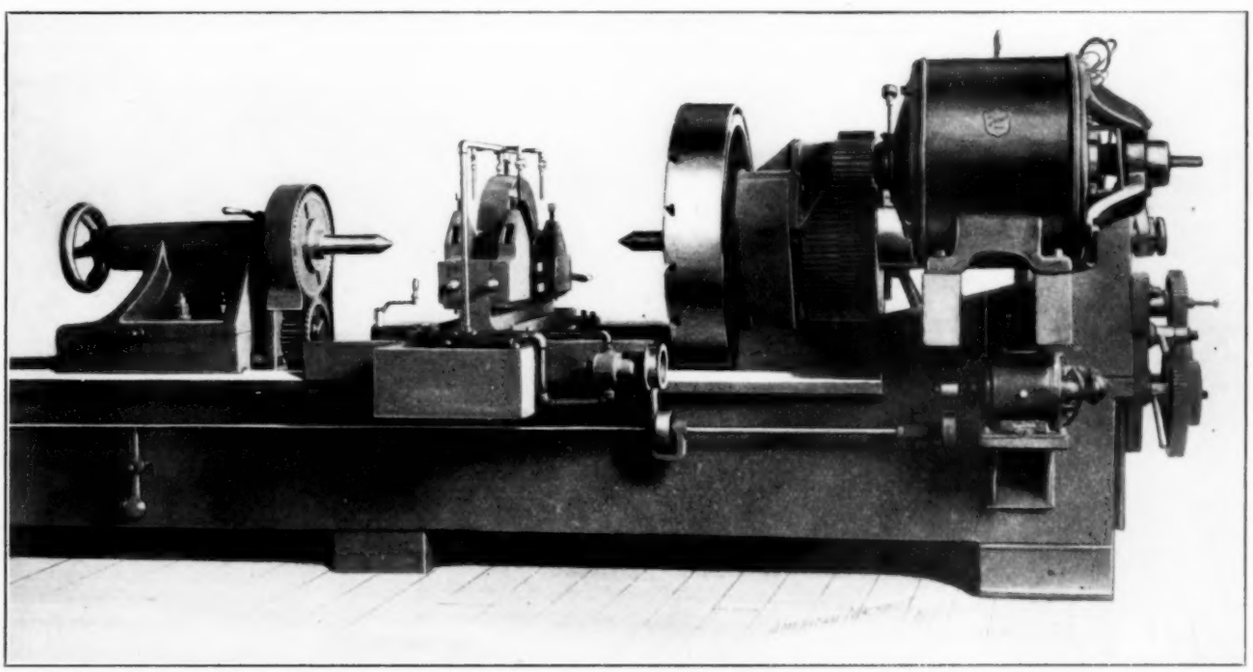


FIG. 2. MOTOR-DRIVEN SHAFTING LATHE.

is mounted on supports formed on the back of the head and connected by spur gears with the spindle; the armature pinion and spindle gear being connected by a raw-hide intermediate. The motor is arranged to run at twenty-six forward and six reverse speeds (these ranging from 200 to 1,450 per minute), and the spindle gear shaft, while the triple gear is controlled by the handle at the front, this sliding a pinion in and out of the internal gear formed at the back of the face-plate. Guards (not shown) are provided for protecting this gearing. The spindle, when driven direct, runs at one-fourth the speed of the motor. The back gear and triple rotated through a shaft at the center of the bed, the shaft being driven by gears which may be connected at will with the gearing at the head. Thus the work may be driven from both ends, or, as the tools approach the head, the dog may be removed from the piece and the latter driven from the other end until the cut is fin-

ished, in the usual way with shafting lathes.

The carriage is fitted with a four-tool shafting rest, and a compound rest is also supplied. The four tool-posts have, as indicated, independent adjustment in and out; a water channel is formed in the casting below, and at the back is secured a pump, tank and piping. The pump is driven, through a shaft and small pulleys, by a Browning ¼ horse-power motor, mounted, as shown in Fig. 2, on a bracket attached to the bed.

The apron, as will be seen by referring to Fig. 1, is practically the same as the one regularly used by this company, and recently illustrated in our columns. It has, however, in addition to the regular mechanism, a controlling shaft and handle by means of which the speed of the driving motor is varied and the motor reversed; while at the left-hand end of the apron is a vertical shaft connected by spiral gears with the rack pinion shaft and with a long shaft near the lower edge of the bed. The latter arrangement provides quick movement for the carriage in either direction. The quick traverse shaft is driven through chain and sprockets from a Browning 1½ horse-power motor mounted behind the bed. The quick traverse gear is thrown in and out by a handle located back of the hand-wheel for operating the carriage by hand, and moves the carriage at about 20 feet per minute. The splined lead screw is driven through change gears, and two cones of three gears each inside the head, the latter gears being controlled by a rod projecting from the head. The longitudinal and cross feeds range from 1-64 to 1 inch per turn of spindle, while threads from 32 per inch to 1 in 2 inches can be cut; the screw-cutting feeds being, with the same gears, twice as coarse as the turning feeds.

The lead screw is provided with four traveling supports, sliding, as indicated, on the "V" at the front of the bed. Two of these travel at either side of the carriage, a spring attachment drawing them along until a point about one-third the way down the bed is reached, when the outer support is stopped and held by a pin in the bed; the other support continues to travel with the carriage until a second stop-pin—placed midway between the first and the end of the bed—is reached. For feeding in the opposite direction these supports are, of course, picked up by the carriage as it reaches them, the two supports at the other side of the carriage then being located as the stop-pins are reached. These sliding supports are made in two parts connected by small pins bent "U" shape. If a support is carried too near the lead screw bracket at the end of the bed the connecting pin is automatically forced back far enough to allow the lower portion of the support to drop, and thus prevent its breaking. Swing supports are provided for the shaft operating the quick traverse gear in the carriage, and also for the pump shaft carried at the rear of the bed. The shaft for the driving plate at the footstock is also well supported.

This lathe has a bed 45 feet long and takes 36 feet between centers. It swings 36 inches, and will handle—with the ring rest—shafts up to 10 inches in diameter, the rest being bored to 11½ inches. It is built by the Draper Machine Tool Company, Worcester, Mass.

A new product of the electrical furnace is siloxicon. It is made from ground coke and sand and forms at a temperature between 4,500 and 5,000 degrees Fahr. It is a valuable refractory material for lining furnaces or converters.

Hunt's Measurements and Drawings—II.

BY JOHN RANDOL.

The example of Hunt's measurements and drawings as used on the horizontal boring machine is the cylinder guides and steam chest, integral, for the same "cable driver," which is the standard for small engines, reversing or non-reversing, according to the valve motion fitted.

It is to be regretted that the entire sheet of drawing for this cylinder cannot be shown, but it has to be dismembered for the sake of clearness, as the page is not large enough to reproduce it entire.

The sheet has the finish-mark explanations given in Table 1. The holes *B*, *C*, *D*, *E*, *F* and *H* are made by the planer

TABLE OF ORDINATES FOR PLANER.

	HOLE.		Gage lengthwise of planer, ¼ in. Sq. C. R. Steel. Mark, I. S. No. 150-O		Gage crosswise of planer, ¼ in. Round C.R.Steel. Mark, I. S. No. 150 O	
	Style and Size.	Limits.	Mark.	Length.	Mark.	Length.
A	Datum Gage		X–A	18″	Y–A	18″
B	1¼″ Drill		X–B	22 1/8″	Y–B	24 3/4″
C	1¼″ Drill		X–B		Y–C	11¼″
D	1¼″ Drill		X–D	4 ft. 4¼″	Y–A	
E	2 3/16″ Drill		X–F		Y–A	
F			X–F	10 3/8″	Y–F	10 3/8″
H	2 9/64″ Drill		X–H	38″	Y–H	22 3/8″

TABLE 3—GAGES FOR HOLE-CENTER LOCATIONS OF ENGINE CYLINDER FIG. 7.

ROUTING CARD.

1	Clean the ports and apply the sand blast before machining the cylinder.
2	Plane the bottom of the palm and drill for the palm bolts, locating the datum line by gages X-A and Y-A.
3	Bore and face the steam chest and hole for the valve stem bushing, using I. S. 27061E for roughing cut and I. S. No. 27061F for finishing cut of the steam chest. (Use same datum lines as for operation No. 2.)
4	Drill and tap for the studs in the steam-chest flange, using I. S. No. 151C; also drill and tap for the steam pipe.
5	Drill and tap for the indicator and drain cocks in the center of the bosses.
6	Plane the top of the crosshead guides and face for the palm bolt nuts.
7	Drill and tap for the oil hole through upper guide into cored recess.
8	Mount on the Betts mill No. 228 or 227, lining up by the core of the cylinder and outer end of the crosshead guides and securing casting by means of bolts through palm bolt holes. Support the boring bar by I. S. No. . . . Bore the cylinder and crosshead guides, using I. S. 27061 for roughing and I. S. 150S finishing the cylinder. Use I. S. 27061C for roughing and I. S. No. 27061D for finishing the crosshead guides; at the same time bore and face the hole for the stuffing box.
9	Face the cylinder-head flange.
10	Drill and tap for the cylinder-head studs, locating the holes by I. S. 154A.
11	Turn the cylinder flanges, using I. S. No. 150W for support.

TABLE 4—ROUTING CARD GIVING SEQUENCE OF OPERATIONS ON THE CYLINDER, SHOWN IN FIG. 7, WITH SPECIFICATIONS OF THE SPECIAL TOOLS TO BE USED.

boring spindle, using gages as specified in Table 3.

The "routing," which directs the order in which operations are to be performed, is specified, together with gages and tools to be used for each operation, in Table 4. The drawing of the cylinder itself is given in Fig. 7.

Enough has been said in regard to the use of the combined planer and drilling or boring spindle to enable the reader to understand the proceedings on that tool. The first operation is to plane the "palm," or surface by which the cylinder is held to the frame. Before this can be done the rear end of the cylinder must have a bridge put in it and be centered thereupon, and a center must also be made in

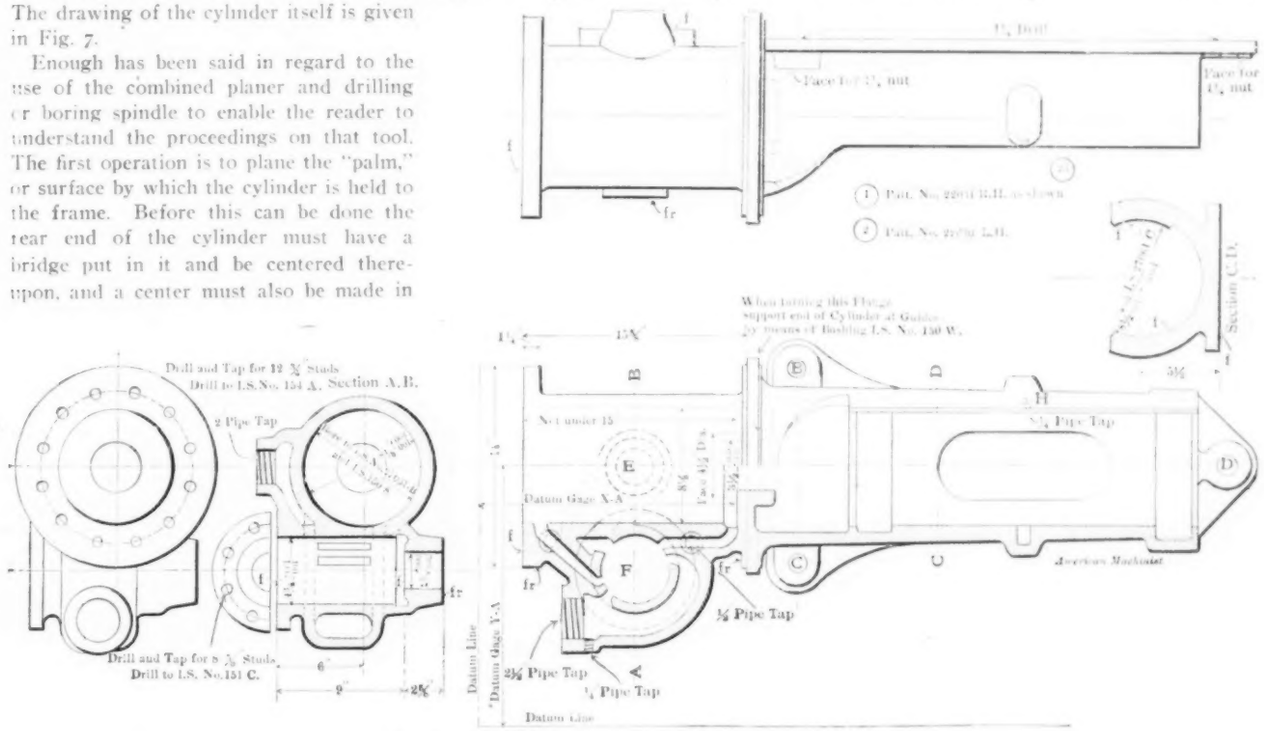


FIG. 7. HUNT'S 8X10-INCH STEAM ENGINE CYLINDER.

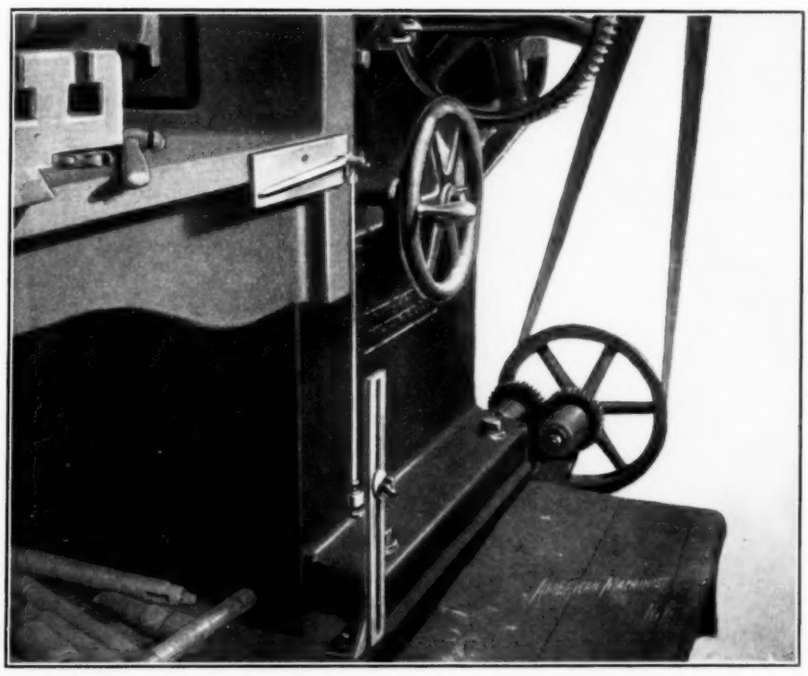


FIG. 8. APPLICATION OF GAGE, ABUTMENT AND INDEX TO BORING MACHINE.

a bridge put in the front end of the guides. Then the casting can be strapped to the planer table, bringing the bridge centers same hight by the surface gage, and also setting these centers in line with the travel of the bed. Then plane the palm surface, 5½ inches, scale measurement, above the bridge centers. See Fig. 7, "section C D."

Now see "section A B," Fig. 7. The left hand side of this figure is the top side while the palm is being planed. The "Routing Card," Table 4, says, section 2, "Plane the bottom of the palm and drill for the palm bolts, locating the datum line by gages *X-A* and *Y-A*." This direction would seem to apply on the boring mill, not on the planer. It seems easier, on the planer, to locate the datum line from the center of the valve seat *F* and the center of the steam pipe *E*, which are both (see Fig. 8) 10⅞ inches from the cross datum line, while *F* is also 10⅞ inches to the right of the lengthwise datum line. *F*, the valve seat, is an important rough casting location, as it is in the middle of the coring, and hence say, not as the routing card says, but that the datum lines shall be fixed by first bringing the planer boring spindle to the center of *F*, Fig. 7, then set the gage abutment in the planer table dog-slot so as to make the index at *B*, Fig. 1, stand at zero with gage rod *X-F*, Table 3, which is 10⅞ inches long. Then by the same 10⅞-inch rod locate *B*, Fig. 2, on the planer cross-rail to the left, so that the index will stand at zero with the 10⅞-inch gage between the abutment screw fixed to the left edge of the boring spindle saddle, and the index carried by the block *B*, Fig. 2, changed over to the left side of the boring spindle saddle. Then for the palm-bolt holes *B* and *C*, Table 3 and Fig. 7, the gage for the lengthwise position of the planer table will be *X-B*, 22⅛ inches long, and the cross-rail position of the boring spindle will be found by use of *Y-B*, 24¾ inches long, for hole *B*, and gage *Y-C*, 11¼ inches long, for hole *C*. This brings the datum line for cross-measurements 18 inches to left of the cylinder and guides axis, same as is called for in line *A*, Table 3. For hole *D*, Fig. 7, the crosswise gage is *Y-A*, Table 3, 18 inches long, which brings it directly in the middle over the cylinder and guides center, and the lengthwise gage is 52¼ inches long, marked *X-D*, Table 3.

Now, see Table 4, section 3, follow the routing card directions to section 6. Then turn the cylinder over on the palm surface, bolt it down to the planer table and complete the operations called for in sections 6 and 7 of the routing card, Table 4.

Then the casting goes to the horizontal boring machine. The holes *B, C, D*, Fig. 7, are so accurately placed that casting is located on the boring mill table by these holes, with the certainty that the piece will stand in line with the boring spindle. Thus the transfer from the planer to the boring mill is made easy.

Equivalents of abutment and index blocks *A B*, Fig. 1, are applied to the horizontal boring machine spindle, so as to gage the spindle traverse to the cross-feed table and to the elevating table, so that all cuts can be located by the use of gages. The vertical gage abutment and index are applied to the boring mill as shown in Fig. 8. The methods of using the gages on the boring mill are much the same as on the planer and driller, and will be readily understood. The 5/8-inch holes for valve cover are jigged. In the case of the boring mill, the datum line always passes through the face-plate axis, and as the drill spindle axis must be brought exactly into the datum line, or plane, rather, the drill spindle saddle which slides on the cross-rail must be fitted so that, in one saddle position, the drill spindle axis will lie in a vertical prolongation of the face-plate axis. This means a pretty good job of fitting, but as it is perfectly easy to either bore a deep hole or turn a long cylindrical piece standing up from the face-plate, it is easy enough to test the accuracy of the drill spindle position, and there is a reamed dowel pinhole through the drill-spindle saddle into the cross-rail, which is said to bring the spindles exactly in line with each other.

The "1500 gear case," Fig. 9, has been taken as an example of finishing on this combined boring mill, slotter and driller, which is shown in Fig. 4, and it is proper to say that, difficult, almost impossible it might be said, as the job appears at first sight, it is nevertheless quickly, cheaply and easily performed, with a wonderfully close approach to accuracy when done.

The part of the gear-case drawing reproduced in Fig. 9 shows two mating halves of an oil-tight gear case for a winding arrangement to give 1,500 pounds pull on the drum, the gears running in an oil bath and being wholly enclosed. The gears run on shafts in the bearings marked *L, M, N, P, R* and *S*, which must be exactly located to ensure precisely mating each other in the two halves of the gear case. The gearing is to do hard work with no care or skilled attendance, and is cased in, oil tight, to keep it clean in the most exposed situations.

There are different sizes of these gear cases; this one shown is the first one made; it was not known whether the holes in the two halves could be brought exactly with each other by gaging, and this first Routing Card (see Table 5) directs a final reaming of the gear shaft bearings after the two halves of the case are bolted together. This is not the practice. The holes are now "blind" or "bottoming"

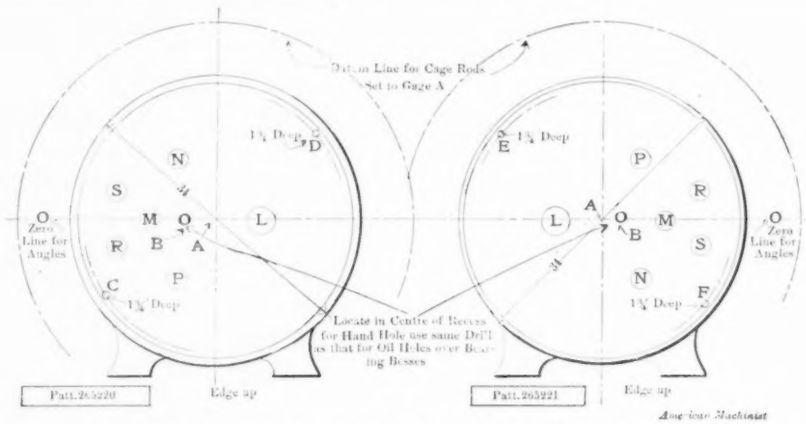


FIG. 9. ELEVATIONS OF THE TWO HALVES OF THE "1500 GEAR CASE."

TABLE OF ORDINATES FOR BORING MILL NUMBER 226. I. S. 26522A.

Holes			Gages, ¼ in. Sq. C. R. Mach. St. Mark, I. S. 26522A.		Angles.			1	2
								Bottoming.	Through.
Let.	Size and Style	Limits	Mark.	Length.	°	′	″	265220	265221.
A			A	25″ + .001 − .001					
B	(See Note)							Drill.	Omit.
C					40	00	00	Drill.	
D	15″ Drill		C	9¾″ + .001 − .001	220	00	00	Drill.	
E	16				140	00	00		Drill.
F					320	00	00		Drill.
L	3½″ + .000 − .001		L	19½″ + .001 − .001	180	00	00	Bottom.	Through.
M	2½″ + .000 − .002		M	17½″ + .001 − .001	00	00	00	Through	
N			N	16.699 + .001 − .001	259	24	59	Bottom.	
P	2½″ + .000 − .002		N		60	35	01		
R			R	13.323 + .001 − .001	16	52	36		Omit.
S	2½″ + .000 − .002		R		343	07	24	Omit.	
½″ tap for motor shaft stuffing box studs				Use Jig 26683B				Drill.	Omit.
⅝″ tap for drum shaft stuffing box studs				Use Jig 26685A.				Omit.	Drill.

TABLE 6—GAGES AND ANGLES FOR HOLE CENTER LOCATIONS OF "1500 GEAR CASE," FIG. 9.

(that is, not bored through) in both halves of the case, so that there is no opportunity for correction by through-reaming. The solid hole bottoms perfectly enclose and protect the gearing, and the boring spindle is so accurately located that the two halves of the gear case match up perfectly, and the gearing runs in the most satisfactory manner.

No more difficult job of machining could be devised than this of boring a lot of blind holes in the insides of two case parts so that they shall line up perfectly when the two halves of the case are bolted together and positioned by the dowel-pins in holes *C, D, E, F*, Fig. 9, which are also blind holes. These gear cases come together right, and no stronger testimony as to the value of Hunt's measurement methods could be given than the truthful statement that this most difficult piece of work is regular practice, and does not give the slightest trouble. The necessity for perfectly enclosing and protecting the gears was the mother of invention, very evidently, in this case.

Passing other details of gear case finishing, the method of locating the gear shaft holes *L, M, N, P, R* and *S* will be shown. Suppose one gear-case-half to be held horizontally in the independent four-jaw face-plate chuck of the boring mill, shown in Fig. 4, as having an independently driven drilling spindle. The holes *L M* lie in the same diameter of the case, and the datum line, or zero line *O-O*, Fig. 9, is made to pass through the centers of the gear-case-half and the centers of *L* and *M* by (1) setting the rim of the shell to run true in the chuck—usual manner, by trial with tool or tram; (2) by turning the face-plate to bring the finish line of the feet parallel to the cross-rail of the boring mill, which (3) brings the centers of the hubs *L M* also parallel to the cross-rail, as the case pattern is right.

The edge of the table (see Fig. 4) is cut with a worm gear of 360 teeth, fitting the hand-crank-driven worm, Fig. 10, which can be placed in engagement with the table teeth, so that the table can be turned one tooth, which is one degree, by one turn of the hand crank. The worm shaft carries a disk *D* which has 60 lines of division, touches the stationary vernier *V* and reads to 1-60 of the disk divisions, all as shown in Fig. 10. The stationary index *I*, Fig. 10, was intended to be used as the zero or datum line index, but it is not convenient to have this index fixed, and *I*, Fig. 10, is not used.

In Figs. 10 and 11 the worm gear cover C is shown, with a movable zero or datum line index I^2, which can be moved anywhere on the edge of the gear cover *C* and fastened in any position by a screw with a pin through it (Fig. 11). The edge of the table, Fig. 11, is graduated in 360 divisions, marked by figures at every tenth division. In placing a gear-case-half, Fig. 9, in the chuck jaws, the workman locates it so that the zero graduation of the table will come between the gear-case feet, and when he has the case chucked with the feet and the zero line *O-O* passing through the center of the case and through the centers of the hubs which surround the two holes *M L*, Fig. 9, parallel to the cross-rail, he sets the index I^2, Figs. 10 and 11, to the zero line on the table edge. Next, he brings the drill spindle to the table axis, inserts the dowel in the hole *D*, Figs. 4 and 12, and then, as directed by Table 6, takes the gage *A*, 25 inches long, places it in the forks *A B*, Figs. 4 and 12, and fastens *B*, Fig. 12, to the cross-rail so that the index *I* stands with its mark. Next he removes gage *A*, Table 6, and takes gage *M*, 17½ inches long, moves the

ROUTING FOR 1500 GEAR CASE.

Sand blast interior of castings thoroughly before machining.

Drill the holes and face the seats for the gear case bolts, and drill the holes for the oil cocks in castings 265220 and 265221 on the vertical boring mill, Number 226 (Pond), Number 225 (Bullard), or on a drill press as may be most convenient.

Mount the "through" side edge upon the vertical boring mill, Number 226 (Pond), the center of the casting to be in the center of the mill, and the zero line for angles to be on the center line through the drum shaft bearing and motor shaft bearing.

Turn and face the flange.

Face the bearing bosses, drill the holes for the plugs over those bearing bosses which are marked finished.

If the hand hole is to be cut through, drill a locating hole in the center of the recess.

Drill and bore the dowel pin holes, locating them by I. S. 26522A. Bore the bearing holes, locating them by I. S. 26522A. Bore for the drum shaft first, then for the motor shaft, and then for the intermediate shafts. Remove the casting from the mill.

Mount the "bottoming" side on the vertical boring mill, Number 226 (Pond), and follow the routing given above for the "through" side.

After machining the bottoming side insert the dowel pins and mount the "through" side on it and bolt both together.

Ream the bearing holes with a long reamer through both sides at once. Drill the holes for the stuffing box studs where required. Use template 26683B for motor and 26685 A for drum shaft. Stud holes to be vertically above and below shaft holes.

For further operations see Drawing 26523.

TABLE 5—ROUTING CARD FOR FIG. 13, "1500 GEAR CASE," SHOWN IN FIG. 9

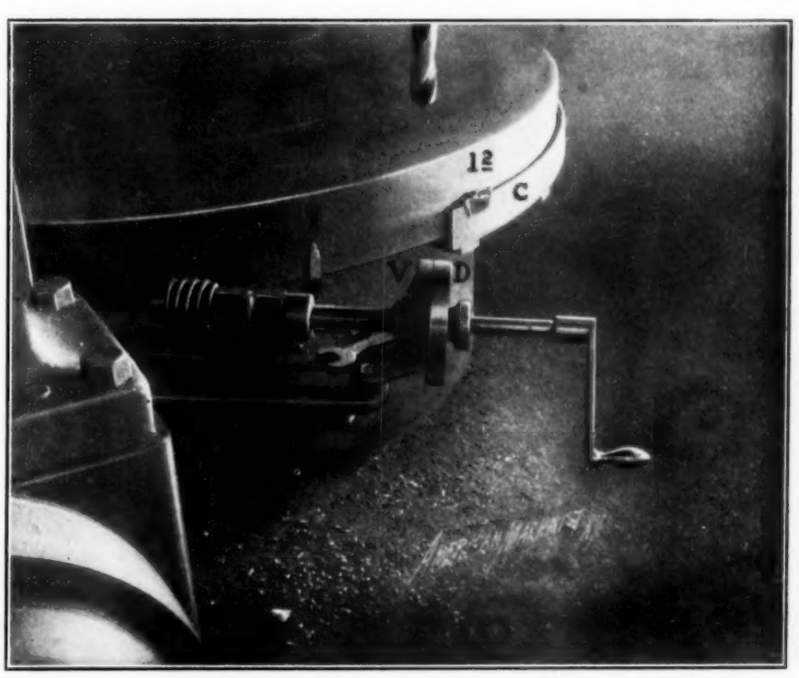


FIG. 10. SINGLE THREAD WORM WHICH MAY BE ENGAGED WITH 360-TOOTH WORM GEAR ON BORING MILL FACE-PLATE.

drill-spindle saddle 7½ inches to the left, which makes gage *M* bring index *I*, Fig. 12, to its mark, and positions the drill-spindle for boring the hole *M*, Fig. 9.

To bore the hole *L*, the table is turned 180 degrees by the hand crank and worm, and the drill spindle saddle is set by using

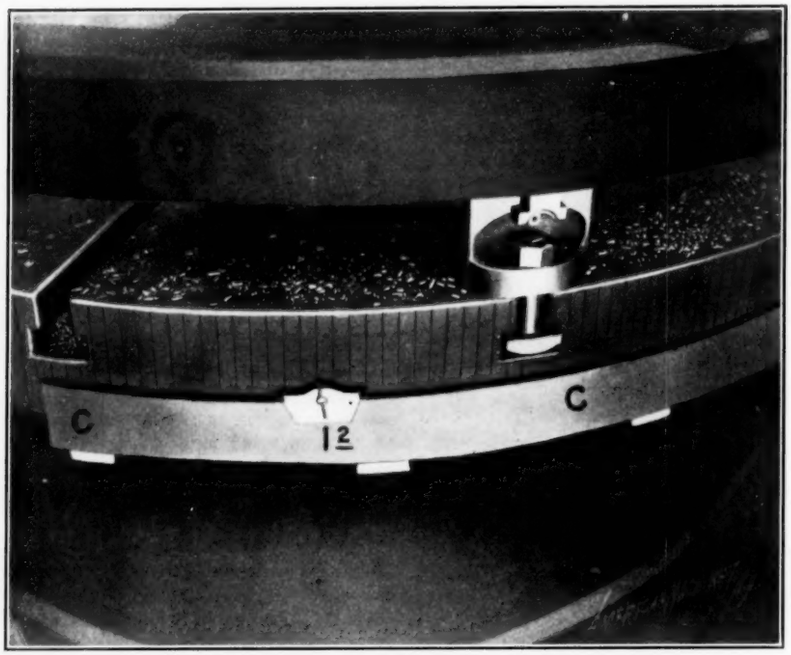


FIG. 11. VIEW OF GRADUATED EDGE OF BORING MILL TABLE.

gage *L*, Table 6, which is specified as 19½ inches long. It will be possible, of course, to set the drill spindle right for hole *L* without moving the table at all, by use of a gage rod 30½ inches long, but in all cases the holes are bored on the left-hand side of the table center, and the table is turned precisely the right distance to bring the hole to be bored into the zero or datum line *O-O*, Fig. 9.

Because the case halves are right and left, and because all the holes are bored to the left of the table center, the feet of the case-half must stand to rear for boring the holes in the right-hand half, Fig. 9, and this makes the hole-designating letters change sides of the *O-O* zero line.

The angles given in Table 6 call for turning the boring-mill table front to the left in all cases; hence for the hole *N* the table must be turned 299° 24′ 59″, while for the corresponding hole *P*, Fig. 9, left-hand figure, the table has to be moved, of course, only 60° 35′ 1″ to bring the center of the hole into the zero line, where it can be correctly bored by setting the drill spindle by use of gage *N*, Table 6, which is specified as 16.099 inches long.

Thus it will be seen that the method of locating the spindle is to work from the table center by first fastening the drill-spindle saddle in the table center line with the dowel in the hole *D*, Fig. 12, then setting the index block *B*, Fig. 12, at a fixed distance, then bringing the axis of the hole to be bored into the zero line, and fixing its distance from the center by the use of its gage rod.

This is a long story to tell, but a very short job to do, and provided the table can be given the correct angular position, the work must come right. The angular movements of the table and the lengths of the gage rods are calculated, the work is done quickly, and comes very little out of the way. In point of fact, the work is so nearly accurate that it assembles with no hand-fitting whatever, and the gearing appears to be perfectly located.

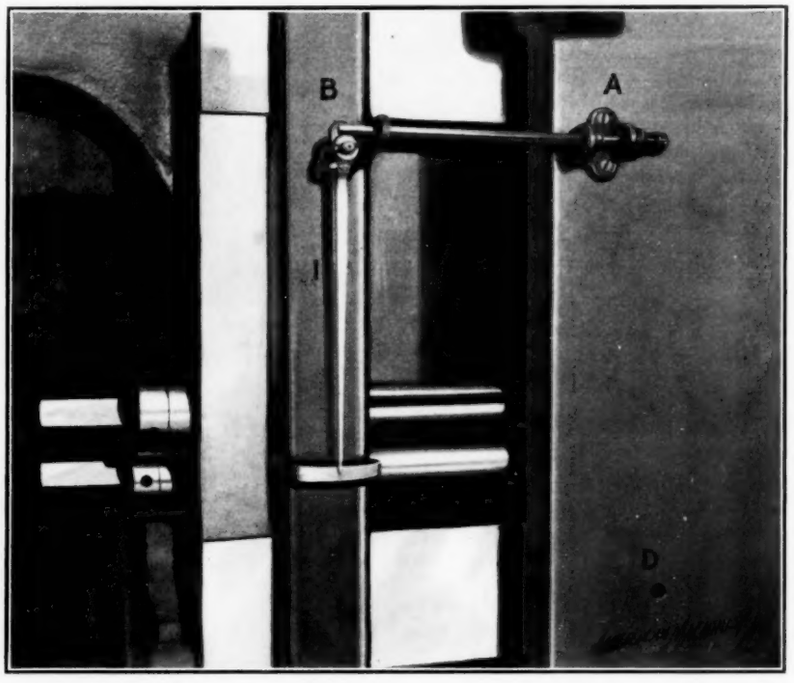


FIG. 12. GAGE, ABUTMENT AND INDEX APPLIED TO CROSS-RAIL OF VERTICAL SPINDLE BORING MILL.

Church, by discarding the use of jigs at the Waltham watch factory and substituting correct spindle location for drill guiding by means of jigs, greatly cheapened the operation of drilling watch plates, and at the same time removed those errors in plate-hole location, which were always discoverable so long as drilling jigs were used. To perform these drilling operations, something over 100 in number, on the watch plates by free cutting tools, held in correctly located spindles, Church built the finest and most elaborate automatic machines ever seen, invented a method of work-locating by means of compressed air driven pistons, and made a new application of grinding wheels by which he could produce centering drills or starting drills precisely alike.

Hunt is the first, so far as known to me, to attempt the finishing of pieces of considerable size by substantially the same methods employed by Church. All of Hunt's work can be brought true with the spindle axis by boring, and Hunt does not automatically bring his spindles to position, as does Church. Hunt and Church both employ steel faces abutting in two different planes to locate the work and spindle. Church's work was infinitely more elaborate than jig making. Hunt, by hand-adjustment of the spindle and work positions, is enabled to use tools vastly cheaper than jigs for the same operations.

Nothing has previously been printed in regard to Hunt's method of locating cuts in machine tool construction, but the system is so simple, and its certainties are so great that, in spite of the combined machine tools which the system demands, it must certainly receive the most careful consideration of machine constructors.

The probabilities of workmen's errors are much smaller by Hunt's system than by ordinary methods. First, the tabulation of the dimensions is easy to read, the drawings are not confused with dimension lines and one drawing can be made to answer for finishing all similar pieces of different sizes by use of different tables of ordinates, or gages.

Again, an end measure is less uncertain in use by a workman than a graduated scale, as the workman may select the wrong line of graduation.

This system is so different from that of measuring the piece itself that the description must be in full detail to make it intelligible, and this gives an impression of complexity which does not really exist.

The workman is perfectly guided by his table of implement marks and by the corresponding marks on the gages themselves, and his task demands much less care and mental effort than the usual methods of measurement.

As for the angular movements of the boring mill table, which seem so complex at first sight, they are really very simple. The angles are tabulated in the drawing room, and as the workman has the zero index for reference from the time he has the piece set, he knows what he is about.

With the datum line located in the middle of, say, a printing press frame, gages 7 feet long would cover 14 feet square, which is a large machine member dimension, very much larger than can be accurately measured by ordinary shop methods without great pains are taken to avoid errors.

The system has been in use in the Hunt shops for several years, and is regarded as perfectly satisfactory there.

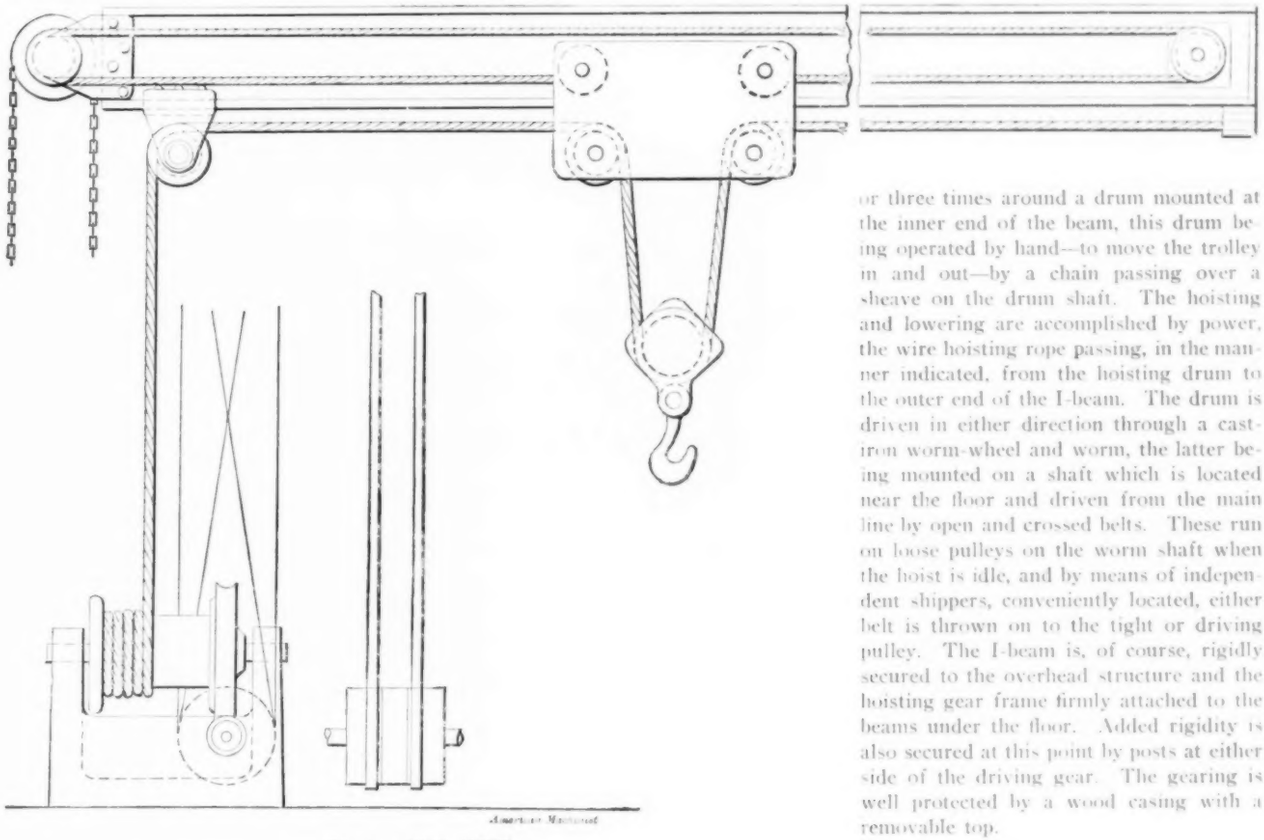


FIG. 1. SHOP HOIST.

Worcester Shop Notes.

A SHOP HOIST.

H. G. Barr, of Worcester, Mass., builder of toolroom grinders, drills and special machinery, occupies the third floor of a large brick building; and to hoist his material from below as well as to lower his finished product Mr. Barr has equipped his shop with a neat hoisting device of his own design, the general arrangement of which is indicated in the sketch, Fig. 1. A 15-inch I-beam is secured to the overhead beams, and this projects from the doorway about 9 feet. A trolley made up of steel plates is mounted on the I-beam, and to this are attached the two ends of a light wire rope, running over a pulley at the outer end of the beam and passing two or three times around a drum mounted at the inner end of the beam, this drum being operated by hand—to move the trolley in and out—by a chain passing over a sheave on the drum shaft. The hoisting and lowering are accomplished by power, the wire hoisting rope passing, in the manner indicated, from the hoisting drum to the outer end of the I-beam. The drum is driven in either direction through a cast-iron worm-wheel and worm, the latter being mounted on a shaft which is located near the floor and driven from the main line by open and crossed belts. These run on loose pulleys on the worm shaft when the hoist is idle, and by means of independent shippers, conveniently located, either belt is thrown on to the tight or driving pulley. The I-beam is, of course, rigidly secured to the overhead structure and the hoisting gear frame firmly attached to the beams under the floor. Added rigidity is also secured at this point by posts at either side of the driving gear. The gearing is well protected by a wood casing with a removable top.

GRADUATING QUILLS.

In graduating (before finishing) the quill used on the Barr drill an arrangement shown in Fig. 2 is employed. This consists of a holder *a* bored to receive the quill *b* and cut away at one side, the vertical surface at the top acting as a guide for the graduating block *c*. The device is used in a screw arbor press, the ram being brought down on the graduating bar, which is set to a line laid off from the end of the quill. The bar *c*, which is of a length sufficient to cover the series of graduations, is of tool steel and hardened. It is made in the milling machine—at least the teeth or graduating ridges are formed there; these are made by sinking a 60-degree cutter in to the required depth, the table being moved along the correct

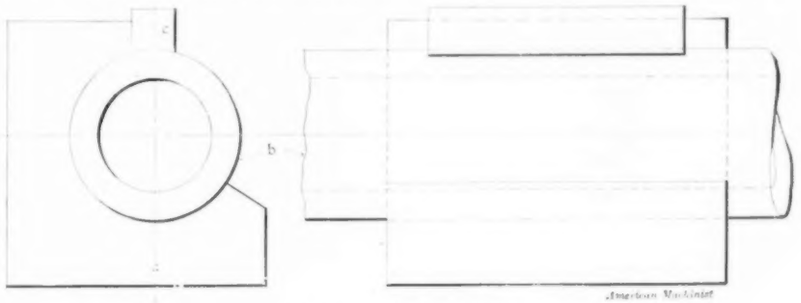


FIG. 2. GRADUATING QUILLS.

distance after each cut. After the teeth are all formed and brought up to a keen edge, the heels or ends of those for the shorter lines are cut away to the required length. F. A. S.

Some Points in Spiral and Worm Gears Learned in a Machine Shop—The Nature of Worm-thread Contact—II.

BY OSCAR J. BEALE.

Friend Grant asks, at page 302, how I make a 7-toothed gear run in a 60-degree V-thread worm without interference; he says that he should have to use 11 teeth at the least.

I think that an excellent explanation of how to avoid interference in low-numbered worm gears is to be found in Section 117 of Mr. Grant's "Treatise on Gears," where he says, "It is a simple matter to avoid the interference by enlarging the outside diameter of the worm gear. If, as shown by Fig. 99, the tooth has but a short flank, or none at all, and the addendum of the gear is about twice that by the usual rule, the action will be confined to the face of the gear and the flank of the worm, and there can be no interference. . . . This method has the advantage that the same straight-sided worm and hob can be used for small gears as for large ones, and the disadvantage that the action is confined to the approach."

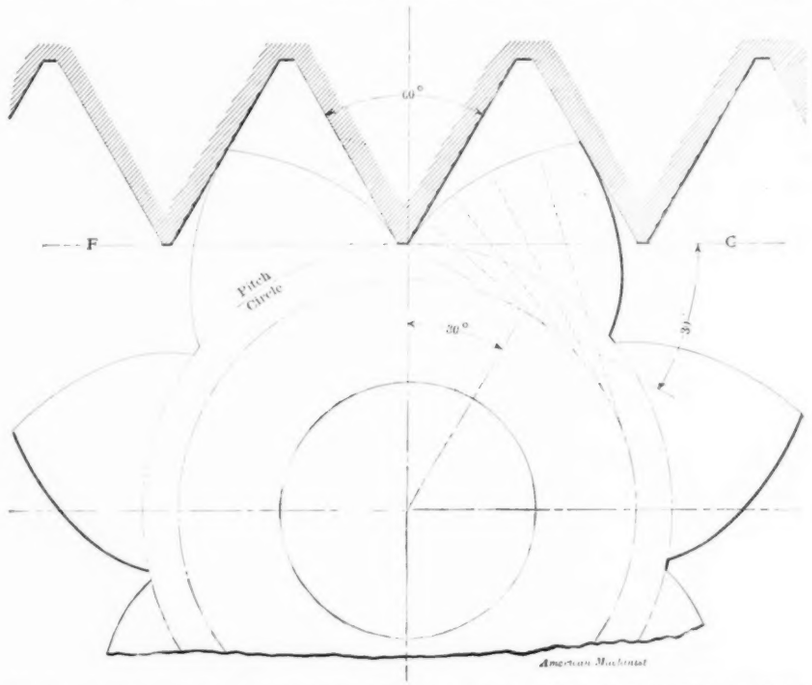


FIG. 11. A WORM GEAR OF SEVEN TEETH MESHING WITH A 60-DEGREE V-THREAD WORM. THE OUTER PART OF THE THREAD JUST TOUCHES THE PITCH CIRCLE OF THE GEAR.

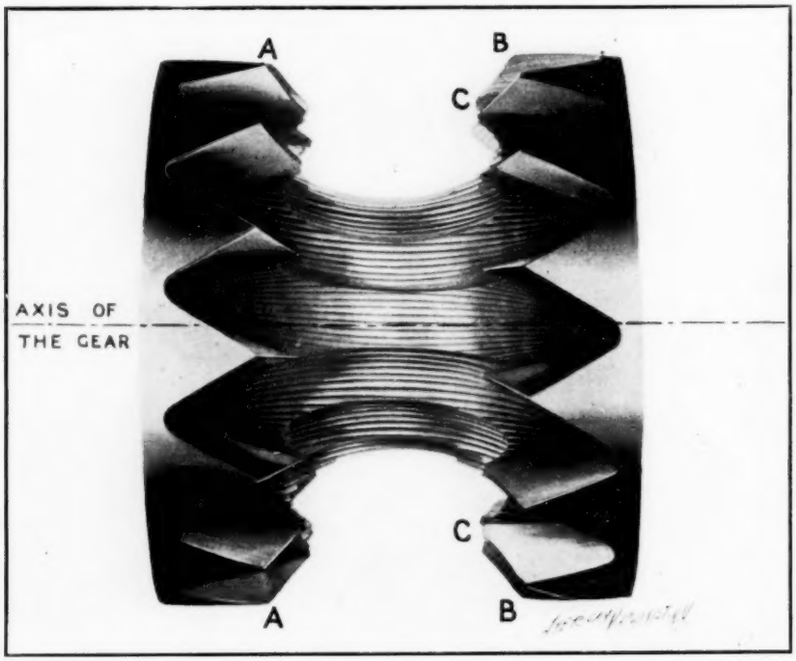


FIG. 10. WORM GEAR OF 14 TEETH, WITH A LARGE PART OF THE TEETH CUT AWAY BY THE INTERFERENCE OF THE HOB.

The method of avoiding interference is also shown in the Brown & Sharpe "Practical Treatise on Gearing."

In saying that he should have to use 11 teeth in a gear to run with a 60-degree thread worm, Mr. Grant means that 11 teeth are required in the gear, in order to have the usual addendum in both the gear and the worm.

The interference referred to is the outer part of the worm thread against the flanks of the worm-gear teeth, and, in hobbing, the interfering flanks are more or less cut away.

Fig. 10 shows a rather pronounced case of the cutting away of the flanks on account of interference, the hob having left only small bits of teeth that are available for action, as at *A* and *B*. At the time the hob began to interfere, there were teeth across between *A* and *B*. As the hob sank deeper a hole was cut through the flank of every tooth. These holes kept enlarging until the hob had cut away a greater part of every tooth, both flank and face, between *A* and *B*, and every tooth has left two stumps as at *A A* and *B B*. The hob has "interfered" with the faces of the teeth, as well as with the flanks, between *A* and *B*. The depth of the acting teeth or stumps is now only the distance between *B* and *C*, which is wholly a face action.

Fig. 10 was cut with the 60-degree hob, which revolved fourteen turns to one turn of the gear. This is the same hob that cut the 7-tooth gear *a b*, Fig. 13.

In sizing the blank for the 7-toothed worm gear, I aimed to have it large enough to let the hob cut the outer part of the teeth to a sharp edge before the hob began to interfere with the gear tooth flanks. The roughing hob was sunk about down to the pitch circle of the gear, and, of course, the teeth then had no flanks whatever, as shown in Fig. 11. When a worm thread just reaches the pitch circle of a gear, as in Fig. 11, and the worm drives the gear, the action is wholly approaching. In this position the worm thread has no face, the pitch line being at *F G*.

In finishing the teeth, the filing hob cut about down to the interfering depth, as shown in Fig. 12, which illustrates the same principle as Mr. Grant's Fig. 99. When the 60-degree V-thread worm is run at this depth, there is no interference, and yet the worm can drive the gear in receding action through an arc of 30 de-

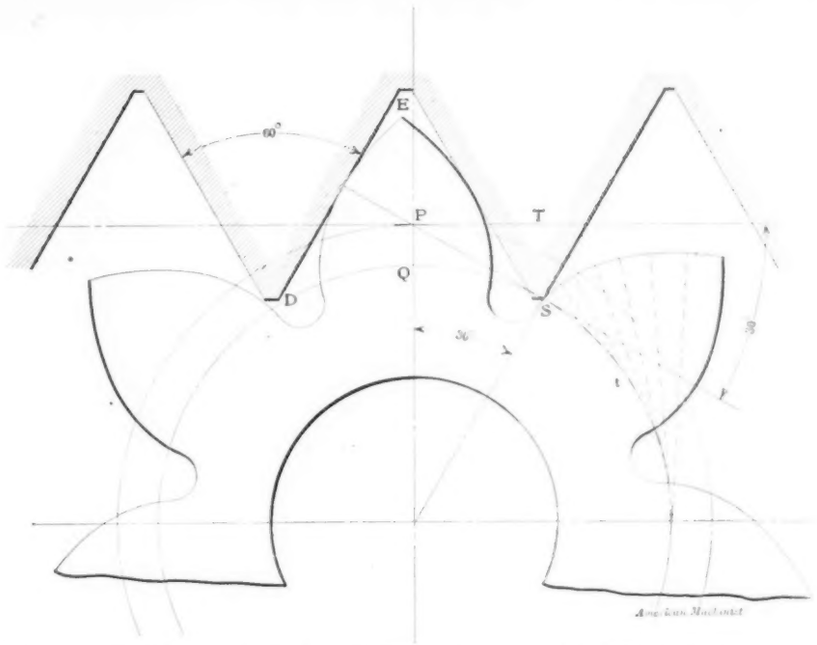


FIG. 12. A WORM GEAR OF SEVEN TEETH MESHING WITH A 60-DEGREE V-THREAD WORM. THE WORM IS DEPTHED JUST DOWN TO THE POINT OF INTERFERENCE.

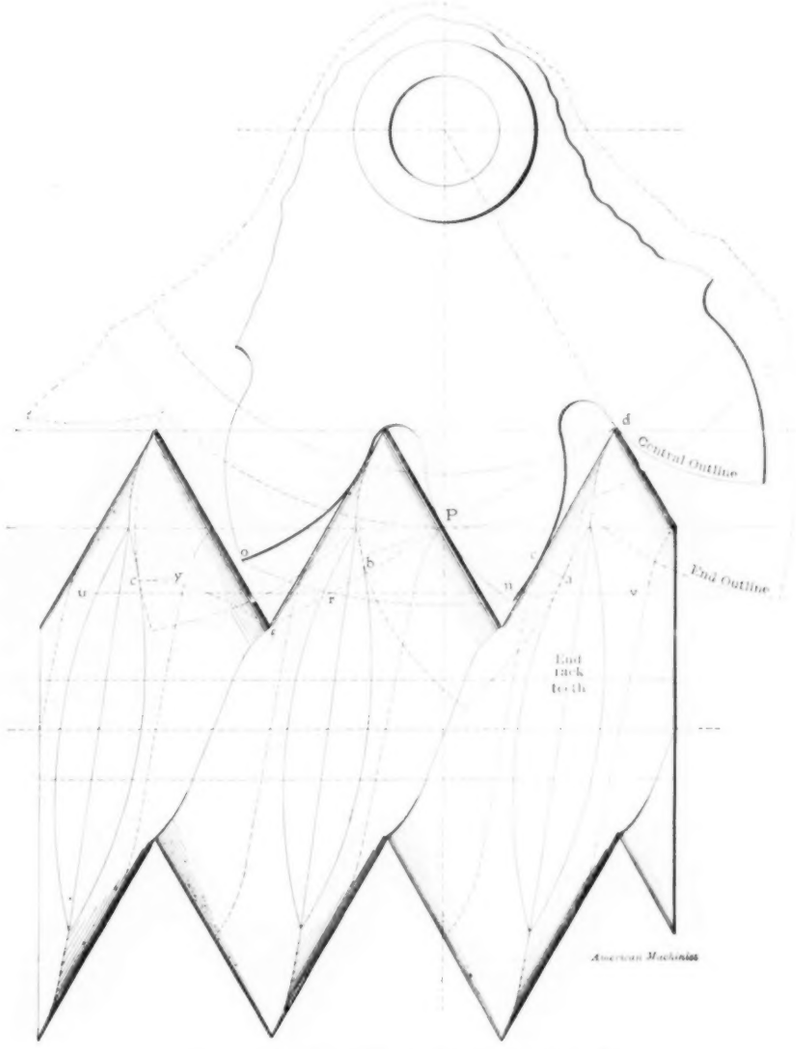


FIG. 13. TOOTH ACTION OF WORM GEAR AND WORM.

grees. The worm thread T is just quitting contact with the gear tooth t, at the point S, after having driven the side of the tooth s 30 degrees to the right of the pitch point P. The arc of receding action is from Q to S. When an involute rack tooth or a worm thread quits contact at the common point of tangency S of the line of obliquity $P S$ and the base circle of the involute $Q S$, the receding action is equal to the angle of obliquity $T P S$. It will be remembered that the angle of obliquity is half the angle of a symmetrical thread $D E S$. It is possible to have an unsymmetrical thread and two angles of obliquity, one on each side of the line $E P Q$.

I admit that "graphical analysis" is sufficient to prove the nature of worm thread contact, but after a diagram has been correctly drawn, it must still be correctly interpreted. Fig. 13 is a copy of a part of Mr. Grant's diagram, page 302. He says that a line of contact is roughly shown by each of the lines $c f$, $b P$ and $c a$. I should think $b P$ and $c a$ are correct, but $c f$ is not quite correct, as a bearing of a gear tooth is never quite so deep on a worm thread as f. The arc $o n$ touching the outer points of the worm-gear teeth at the central section of the gear lacks considerably of being so deep as f. The lowest depth of bearing upon the worm thread reached by the central section of the gear is at r, where the arc $n o$ intersects the path of contact $d P r$. The line $n r$, through the point r and parallel to the axis of the worm, indicates the lowest contact points of the central section of the gear. The point r, Fig. 13, corresponds to the point S, Fig. 12. The point of the tooth o, Fig. 13, clearly shows that there is no contact near f. The real contact is quite short, say, about as long as $c y$ and somewhat in the direction of $c y$.

This short contact is shown by the models, Fig. 14, between W and X. The tooth also just touches the worm thread near Z. Between W and Z there is no contact, but an open space. This space at h is more than .03 inch wide. Another open space is seen at i.

Mr. Grant's diagram is very interesting and instructive. It clearly shows that the drawing of the line $c f$ is a mere slip of the pen. His defence of "graphical analysis" against my inference that it is deficient when applied to so crooked a subject as tooth contact in worm gearing suggests a line of thought as to how we know facts beyond doubt. If my worm-gearing models should not agree with graphical analysis, I should first look for a flaw in the analysis. I have in my desk a sketch by Waubug, showing his analysis and figuring for a 2-ton lift by means of a belt, two worms and two worm gears. Upon trial, his "lift" could not even lower his 2 tons. On the other hand, I should never make a model to rectify the circumference of a circle. No man should ever try to prove with a model that the sum of

three angles of a triangle is equal to two right angles.

It would also appear that with some problems it is difficult to tell whether a model or some other method would afford the better solution.

Mr. Grant wishes me to make a model of a Hindley worm and gear. I have had this in mind for a long time. There may be some question as to what really constitutes a Hindley worm and gear. A worm that has been used for fifty years now looks somewhat like the illustrations that I have seen of the Hindley, and it no doubt serves the purpose aimed at by Mr. Hindley, but it would be difficult to reproduce with cutting tools. I should say that the Hindley worm is a sort of cam, and that it does not involve much of the principles usually employed in the construction of gearing. Perhaps this is one of the cases in which we cannot form a decided opinion, beforehand, as to what can be done with a model as compared with graphical analysis.

I hope soon to form an opinion sufficiently decided to go on and construct a model of the famous Hindley worm and gear.

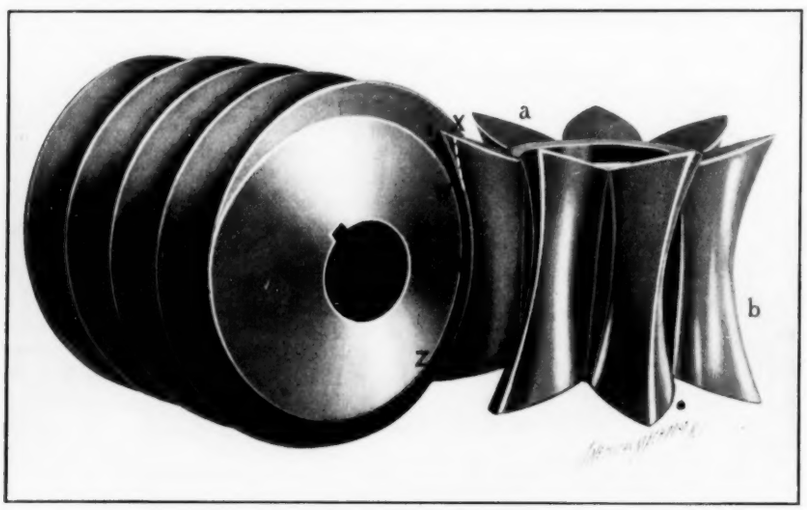


FIG. 14. WORM AND GEAR INDICATING TWO SHORT LINES OF CONTACT BETWEEN THREAD AND A TOOTH. ALSO SHOWING OPEN SPACES BETWEEN THREAD AND A TOOTH.

Sizes of Motors Required to Drive Presses.

BY F. C. FLADD.

I presume it may be of interest to many of your readers to know what size electric motor will drive a given size power press. It certainly has been interesting to me to see the large number of presses and metal working machines that are electrically driven, and the constantly increasing demand for self-contained machines which can be placed in any part of one's works, where it is most convenient for the work to be done, saving in many cases more than the cost of a motor, in the labor of carrying the stock from one end of a building to the other, simply because the power press has to be placed where the line shaft power can be had, while with the motor-attached press these conditions are entirely changed as it makes very little difference where the press is located, so long as the feed wires can be carried to the motor, on or near the press. I shall assume that the reader is familiar with the sizes and styles of the various makers of the presses mentioned, so that he may make comparisons without further details. Below are given the horse-powers of the motors attached to some power presses which I have found in actual use in my experience among press users. These motors are made by the various makers and are all doing good, satisfactory work. Some are direct geared, some belt driven, and some using the silent sprocket chain drive, all good methods under certain conditions. Personally I am inclined to favor the belt drive which gives a little elasticity between the motor and the press, saving the motor to some extent from the severe load suddenly thrown upon it at times.

When starting a motor attached to a press it should be done very carefully and slowly, as it takes more power in many cases to start the large heavy flywheels and get them up to the proper speed, than is consumed when the machine is doing its normal work.

Name and number of press	Horse power of Motor required
Bliss, No. 21	2
Bliss, No. 20	1
Bliss, No. 19	1
Bliss, No. 18	½
Bliss, No. 52	2
Bliss, No. 30A	3
Bliss-Stiles punch, flywheel pattern, No. 0	½
Bliss-Stiles punch, flywheel pattern, No. 1	1
Bliss-Stiles punch, flywheel pattern, No. 2	1
Bliss-Stiles punch, flywheel pattern, No. 3	2
Bliss-Stiles punch, flywheel pattern, No. 4	3
Bliss-Stiles punch, flywheel pattern, No. 5	3
Bliss-Stiles punch, geared pattern, No. 5 doing heavy work	5
Bliss, geared for heavy work, No. 36	5
Bliss, double crank geared, No. 3½	5
Bliss, double crank geared, No. 5	7½
Bliss circular shear, No. 105	½
Bliss double action, fitted with double roll feeds, No. 68N	2
Stiles special five-slide gang press, geared, No. 102	3
Bliss automatic feed armature disk press, No. 16A	1
Bliss toggle, No. 3½	10
Bliss-Stiles 200-pound automatic board lift drop, improved	3
Bliss-Stiles 400-pound automatic board lift drop, improved	4
Bliss-Stiles 800-pound automatic board lift drop, improved	7½
Hilles & Jones combined punch and shear, No. 2	5
Ferracute, No. SG86	5
Ferracute, direct geared, No. C5	3
Ferracute, 18-inch throat, No. P21	2
Bliss, geared with side cut-off attachment, No. 74½	3
Bliss, deep throat for light punching, No. 47½	1
Hilles & Jones, combined punch and shear, No. 3, 36-inch throat, capable of punching 1¼-inch hole through 1-inch stock	10
Hilles & Jones, combined punch and shear, No. 3, 12-inch gap, punching 1-inch hole through 1-inch stock	7½
Hilles & Jones, single punch 36-inch throat, punching 1½-inch holes through 1⅛-inch stock	10
Hilles & Jones, horizontal punch, No. 3, 20-inch throat punching 1-inch holes through ¾-inch stock	7½
Hilles & Jones angle shear, No. 3 cutting 6x6x1-inch stock	10
Williams & White, bulldozer, No. 6, 20-inch stock, 38-inch die face	7½
Bliss geared power shear, 36-inch cut, cutting sheet steel ¼-inch thick	5
Heavy alligator geared cut-off shear, capable of shearing 5-inch by 1-inch bar iron	5
Small armature disk notching press	1
Large coining presses at U. S. Mint, striking up silver dollars, revolutions per minute, 80; pressure, 160 tons	7½
Smaller coining presses, striking up quarter dollars, revolutions per minute, 100; pressure, 60 tons	3
Planchet presses at Mint, double roll feed	3
Double cut-off shear at Mint	3

Some factory managers prefer to run their power presses in groups, using one motor for several presses. The following group is run with a ten horse-power motor:

1 Bliss double crank flywheel, No. 95.
1 Bliss double crank geared, No. 96.

1 Bliss, No. 18.
3 Bliss, No. 19.
2 Bliss, No. 20.
1 Bliss, No. 21.
1 Ferracute small armature notching.

A very interesting motor-driven group came to my notice recently in which there were 28 presses as follows:

8 Philadelphia, No. 2.
8 Bliss-Stiles, punching, No. 3.
2 Bliss-Stiles, punching, No. 5.
10 Waterbury-Farrel F. & M. Co., Nos. 4 and 5.
1 Waterbury-Farrel F. & M. Co., heavy knuckle joint.
1 Waterbury-Farrel F. & M. Co. pillar 2.
2 Bliss small flywheel bevel, No. 10.

A thirty horse-power motor was used to run this group and from it the following readings were taken:

	H.-P.
Starting up this group.....	15
All machines working under normal conditions, including shafting.....	11½
All machines running idle.....	7½

Allowing 2½ horse-power for the shafting leaves but 5 horse-power for the idle presses. Many of these presses were being run by skillful operators at a speed of 80 to 110 pieces per minute when under normal load.

Another group of 60 power presses is being driven by four motors of 10, 7½, 5, and 5 horse-power, respectively, each motor driving a section of line shaft from which the presses receive their power. The 10 horse-power motor drives the following presses:

2 Bliss-Stiles flywheel punching, No. 5.
1 Bliss-Stiles flywheel, No. 74W.
1 Bliss-Stiles geared, No. 73½.
2 V. & O., No. 3.
1 Stiles-Fladd, No. 20.

The 53 other presses of this group are chiefly Bliss No. 18, 19, 20 and smaller, though there are six quite large Bliss machines among the number. There seems to be ample power in this press room. The arrangement gives good satisfaction and is very convenient.

Two-Speed Countershaft for Planer.

We illustrate herewith a novel design of countershaft made especially for driving planers and so constructed that the platen, while reversing, or returning at a constant rate of speed, has two different forward or cutting speeds.

Fig. 1 shows this countershaft assembled and belted, and Fig. 2 gives a sectional view showing the special features of construction. In the former engraving, *a a* are tight and loose pulleys for the belt driving the counter proper; *b* is the pulley for returning the platen; *c* is the pulley for driving the platen on the cutting stroke. The latter pulley is really a two-step cone, being formed with pulley *d*, while at the right of the latter is loose pulley *e*, and the belt through which the speed of the planer is increased. Referring to Fig. 2, the manner in which *c*—and consequently the planer platen—may be driven from either of the belts from the main line will be apparent. The large pulley *b* is secured, as shown in this engraving, to the shaft, and on its hub is fastened a disk *f*. Pulley *c d* which fits loosely on the shaft carries fast on the hub a disk *g* to match *f* and between the two is placed a leather washer. On the hub at the small end of the pulley is formed a left hand thread, and a disk *h* is threaded to fit this freely. Disk *i* is pinned fast to the shaft; a leather washer is placed between *h* and *i*, and to the right of the latter is loose pulley *e*.

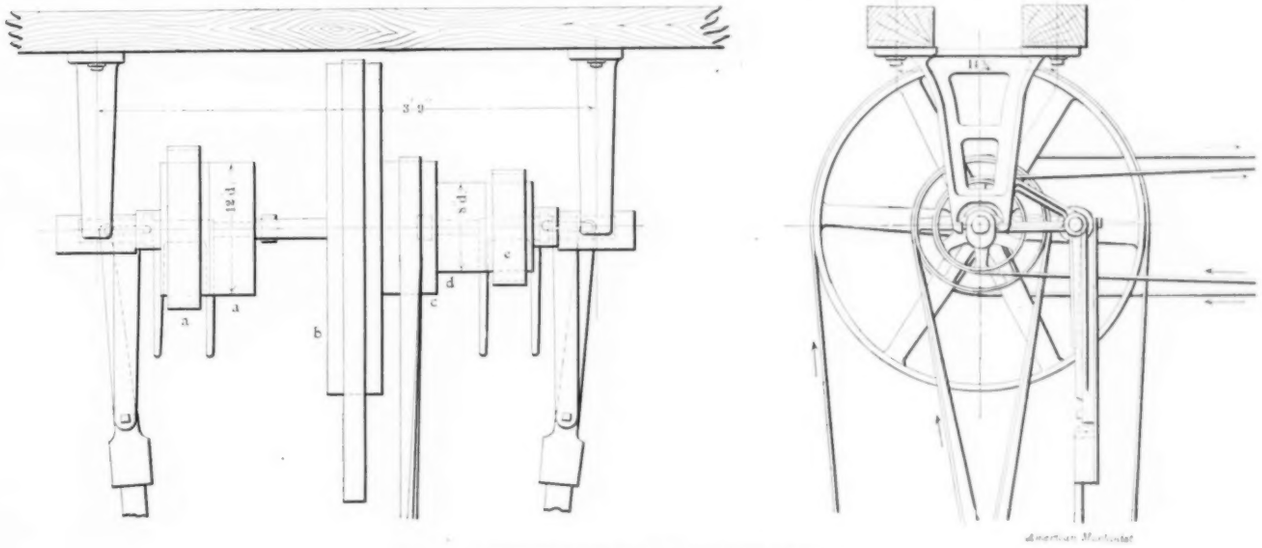


FIG. 1. TWO-SPEED COUNTERSHAFT FOR PLANER.

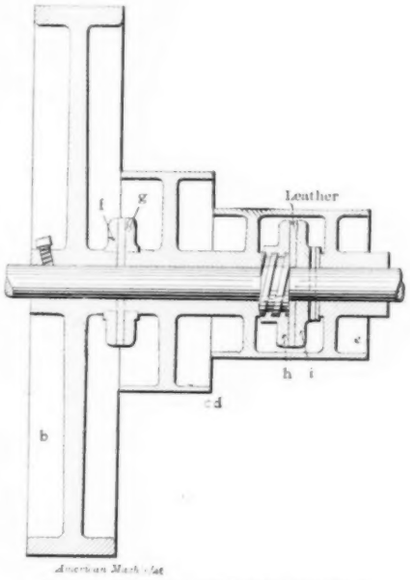


FIG. 2. SECTION THROUGH PULLEYS.

To start the countershaft the belt on *a a* (Fig. 1) is shifted to the tight pulley where it remains so long as the counter is to be operated; pulley *b* and disks *f* and *i* are, of course, started with the shaft. Friction is created immediately between disks *h* and *i* and the leather washer between them; *h* turns with *i*, and, rotating in the direction indicated by the arrow in Fig. 1, screws outward on the threaded hub of pulley *c d* thus clamping this pulley fast between disks *f* and *i* and causing it to turn with the counter. When it is desired to increase the speed of the work—owing to a change in the material, depth of cut, or other reason—the right hand shipper is operated, throwing the belt at this end onto the small step of pulley *c d*, the thread on the end of the hub then drawing disk *h* away from its friction washer and allowing the pulley to be driven by the high speed belt independently of the countershaft.

This countershaft is made by the Whitcomb Manufacturing Company, Worcester, Mass.

A Work in Progress Record.

BY KENNETH FALCONER.

At page 578 appears an article under the above title, in which is described a method of keeping in close touch with the work in progress used in the shops of the C. B. Cottrell Sons Company, Westerly, R. I. The author states that, so far as he knows, no other factory is using an equivalent of this device.

The accompanying forms were devised and have been in use by the writer for some two years with the same purpose in view, viz.: to furnish a "history of each productive order as the productive events occur." Fig. 1, of which the back is here shown, was devised for this purpose; the other forms are simply illustrated here to show their connection and the manner in which the desired information reaches the Index Card (Fig. 1).

As each manufacturing order is issued Figs. 1 and 2 are made out. The former is a 3x5-inch card and contains on the face full particulars of the order; the back is shown (Fig. 1), the dates thereon having been inserted with a dating stamp from time to time by one of the office boys. In the particular case for which this plan was devised the storekeeper acts as the distributer of material, and is responsible for the proper material being sent to the shops for use on each individual order. The Order Ticket (Fig. 2) contains the date, order number and details of the order, exactly as are entered on the front of Fig. 1. With the two coupons attached, it is sent to the storeroom and within twenty-four hours the office must have returned that part marked Fig. 2B, indicating the disposition that has been made of the order. In the case illustrated, part of the material has been sent up to the shops, the remainder being castings for which a pattern has to be made. This information is noted by means of a rubber dating stamp on the index cards, which are kept in a drawer arranged numerically. At this stage it is evident that if further information were required as to the unsupplied material the pattern keeper would be the party asked.

Fig. 3, which is made out in duplicate, one copy being kept by the storekeeper, supplies information as to the shortage yet to be supplied, and is filed in the index directly behind the card bearing its number. (It may be stated that each morning, at a certain hour, all cards and records from every department in the establishment are collected and brought to the office.) In the case under considera-

TICKET to SHOP	ALL UP	SEE REPORT	IN HAND IN SHOP
			Feb. 8
PART UP see sh'p	SHORTAGE UP	CASTINGS required	PATTS to be made
Jan. 20		Jan. 20	Jan. 20
PATT'S to F'D'Y	C'ST'GS in HAND	C'ST'GS FINISHED	C'ST'GS UP
Jan. 23	Jan. 30	Jan. 30	Feb. 5
REMARKS	On Acct. 50 Feb. 12 Balance 150 Feb. 14		

FIG. 1 Index Card

SHORTAGE TICKET.

Date, Order No.

For

Form 01-19.

Short

FIG. 3

ORDER FOR CASTINGS.

Date No.

RETURN THIS CARD TO FOREMAN WHEN ABOVE ARE CAST.

Finished | Noted | Up

FIG. 4

FOUNDRY REPORT CARD.

No.

Detach and return to Office when castings for above are

PUT IN HAND.

Date

Signed

FIG. 4A

PATTERN ROOM REPORT CARD.

No

Detach and return to Storekeeper when patterns are

SEND TO FOUNDRY

Signed

Storekeeper to initial and return to Office

Signed

FIG. 4B

Date,

FROM DEPT. to

Order No.

For

Signed

FIG. 5

Memorandum of Completion of Goods

Stores Report Rec'd	No.	Shops			Castings			Remarks
		In Hand	All Mat'l Up	Part Mat'l Up	Cast	In Hand	Ordered	

American Machinist

FIG. 6

Assistant Superintendents Memorandum

tion the pattern was finished and sent to the foundry on January 23. This information reaches the office by means of the coupon 4B attached to the Order for Castings (Fig. 4). It will now be seen that the office knows exactly how far work has progressed with regard to getting the castings necessary to supply the shortage. On January 30 the information was supplied by Fig. 4A that the castings had been put in hand, and on the same date the Order for Castings was returned to the office

signed by the foundry foreman as finished. This information was noted on the Index Card and the date stamped on the order for castings in the space marked "Noted." The Order for Castings was then sent to the storekeeper, and it was "up to him" to get the goods out and delivered to the shop with as little delay as possible.

When the first material was sent to the shop the Order Ticket (Fig. 2) with attached coupon 2A accompanied it. When the work was put in hand the coupon was detached, the number of the workman marked on it, and it returned to the office. From this coupon (Fig. 2A) the information was noted on the Index Card that the work was in hand in the shops. On completion either in part or full quantity a card (Fig. 5) is made out and sent with the goods to the stock-keeper, by whom it is initialed and forwarded to the office. In the case of stock orders this card is simply filed behind the index card to save time of entering. In the case of orders for articles being made especially for customers, the quantity received by the stock-keeper is noted on the index card and the card (Fig. 5) sent to the billing department, where it is held until a charge slip is received and an entry for the goods. This is to eliminate the possibility of any article specially manufactured being shipped to a customer and no charge billed against him.

Fig. 6 represents a page of a memorandum book* always in the assistant superintendent's possession except for an hour each morning, when the boy is transferring to it the same information which he notes on the index cards. On the completion of an order its number in this book is scored out, all other information regarding it being indicated by crosses in the proper column. This book, however, has only recently been introduced, and its practical value remains to be proven, although it would appear that it kept the assistant superintendent in close touch with work in progress, as the index cards do the office.

Like the Cottrell form described in the article already referred to, the index card does not deal with values or costs. It was devised not so much to present completed records of the progress and termination of orders as to keep those interested in constant information as to how far each order has progressed toward completion.

ORDER TICKET

Date ..... *Order No.* .....

Shop Report No. .....

THIS ORDER PUT IN HAND

WORKMAN No. .....

Foreman.

STORES REPORT. *No.* .....

ALL UP	
PART UP See Storage	X
CASTINGS Required	X
PATTERN Being Made	X

Remarks,

Date .....

FIG. 2 FIG. 2 A FIG. 2 B

The small projecting tab shown on Fig. 1 simply indicates the month in which the order has been issued. The cards representing the finished orders being removed from the drawer immediately on completion, it will be seen that each time this index is referred to the proportion of unfinished orders remaining over from each of the previous months is very apparent. The tab furthest on the left, of course, represents the oldest orders, and if tabs in a given position seem to amount to a greater number than is justifiable measures are taken to look after such orders and get them through.

Stock Owning Without Speculation.

There is another point of view, the influence upon the prudent workman of distracting anxiety in regard to the absolute safety of what may be his sole provision for old age. He will see every morning the Stock Exchange quotations, for the American workman reads the papers. Only recently he would have seen the preferred stock of the United States Steel Corporation temporarily quoted lower than the price charged for it to him. This may mean little to the man of affairs familiar with the ups and downs of the mercurial Stock Exchange. But what must be the effect upon the uninformed workman? Of this I am well assured, the workman whose thoughts are upon the speculative surprises of the Exchange will not prove desirable. Speculation is the parasite of business, feeding upon values, creating none, and is wholly incompatible with the satisfactory performance of other regular work requiring constant care and caution. The workman's investment should never be at risk, for if his thoughts are upon the Stock Exchange they cannot be upon the machinery, and machinery, like art, is a jealous mistress, brooking no rival claimant to its absorbing demands. In the interest of the employer, therefore, as well as that of the workman, the savings of the latter should be secure—here, as in other respects, their interest is mutual, and hence I believe the needed change will be made by the Steel Corporation in the near future. I cannot speak too highly of this experiment, nor give the Steel Corporation too much credit for making it, since it is declared to be in the experimental stage, and subject to future improvement, as all new schemes should be. Its able and progressive author, Mr. Perkins, is to be heartily congratulated.

Thus we see, gentlemen, that the world moves on step by step toward better conditions. Just as the mechanical world has changed and improved, so has advanced the world of labor from the slavery of the laborer to the day of his absolute independence, and now to this day, when he begins to take his proper place as the capitalist-partner of his employer. We may look forward with hope to the day when it shall be the rule that the workman in partnership with capital, the man of affairs giving his business experience, the workingman in the mill giving his mechanical skill to the company, shall be both owners in the shares, and so far equally interested in the success of their joint efforts, each indispensable, without whose co-operation success were impossible. It is a splendid vista along which we are permitted to gaze.

Perhaps I may be considered much too sanguine in this forecast, which, no doubt, will take time to realize, but as the result of my experience I am convinced that the huge combination, and even the moderate corporation, has no chance in competition with the partnership which embraces the principal officials and has adopted the system of payment by bonus or reward throughout its works. The latter may be relied upon as a rule to earn handsome dividends in times of depression, during which the former, conducted upon the old

* This book has since been replaced by the required number of loose sheets held in a spring binder. When all the numbers on a sheet have been marked off as finished the sheet is removed. Remaining numbers are of course always in their proper sequence.

plan, will incur actual loss, and perhaps land in financial embarrassment. In speaking of corporations we must not forget, however, that there are many which are corporations in name only, their management being the life work of their few owners. These rank with partnerships, having all the advantages of this form. The true corporation is that whose shares are upon the Stock Exchange, and whose real owners change constantly and are often unknown even to the president and directors, while to the workmen they are mere abstractions. It is impossible to infuse through their ranks the sentiment of personal regard and loyalty in all its wonderful power. The step taken by the United States Steel Corporation is therefore no surprise to me, for I have long believed that such corporations would be compelled to adopt the best attainable substitutes for the fruitful features of the newer system or suffer eclipse. In the sagacious policy of the United States Steel Corporation I see proof of that opinion, nor can I suggest a better form than that which it has adopted, always provided the workingman shareholder be secured against loss.

In the percentage allotted by the plan to reward exceptional officials we have for the huge corporation perhaps the best substitute attainable for the magic of partnership, which nothing, however, can approach. The reward of departmental officials may readily be secured under this provision. In the bonus granted yearly upon shares held by employees we have proof of regard for them which cannot but tell, and the distribution of shares in the concern among them has an advantage which so far even no partnership has enjoyed. The latter will no doubt adopt the plan or find some equivalent, for the workman owning shares in absolute security will prove much more valuable than he without such interest, and many incidental advantages will accrue to the company possessed of numerous shareholding employees, who may some day see their representative welcome to the Board of Directors. This would prove most conducive to harmony, knowledge of each other on the part of owners and workmen being the best preventive of dissatisfaction.

If the investment of the workman's savings be made secure, the rapid extension of the plan seems certain and can be hailed with unalloyed satisfaction, but in its present form it is obviously incapable of general application, since the officials of few corporations could or would incur the responsibility of inducing their workmen to invest in their shares as a security, and few corporations could or should inspire the needed confidence of labor that these are to enjoy an unbroken career of prosperity, for such has not been the history of manufacturing concerns generally.

The idea of making every workman a capitalist and of sharing large percentages of the profits among those rendering exceptional service will probably encounter the opposition of the extremists on both sides, the violent revolutionist of capitalistic conditions, and the narrow, grasping employer, whose creed is to purchase his labor as he does his materials, paying the price agreed upon, and there an end. But this opposition will, we believe, amount to little. It will even speak well for the new idea if scouted by the extremists and commended by the mass of men who are on neither dangerous edge, but in the middle, where usually lies wisdom.

Meanwhile, here is the germ of a promising plan offered as a solvent for one of the pressing problems of our age, which may prove capable of development. As members of the institute, let us receive, study and discuss it with open mind. That the problem will be solved, and that the two allies are some day to live in friendly co-operation, let no one doubt. Human society bears a charmed life. It is immortal and was born with the inherent power or instinct, as a law of its being, to solve all problems finally in the best form, and among those none more surely than that vexed question of our day, the relations between these Siamese twins, which must mutually prosper or mutually decay—Capital and Labor.—*From Andrew Carnegie's address before the Iron and Steel Institute.*

An Up-To-Date Gas-Electric Power Plant.

The power plant of the new gas works (one of the largest in the country) of the Milwaukee Gas Light Company is a suggestive illustration of the changes which are taking place in the practices of power generation and transmission. This plant requires various auxiliaries throughout the works and for their operation nothing would have been thought of a few years ago but steam. Now steam does not seem to have been thought of for the purpose. Although no electricity is required to be generated for outside service it is still to be employed throughout the plant for power purposes and for the incidental lighting of the works, and gas engines are to be used to supply the power for the generators.

The equipment comprises a 250 horse-power horizontal double-acting gas engine driving a 150-kilowatt generator and three 125 horse-power vertical gas engines belted each to a 75-kilowatt generator. The horizontal engine is of the new type recently introduced by the Westinghouse Company. It has a pair of cylinders arranged in tandem and operating on the double acting principle, a single crank and water-cooled pistons. Coal will be unloaded from boats and elevated to the storage bins by electric hoists and conveyors, the retorts will be charged and drawn, the coke will be finally disposed of and a large machine shop will be driven, all by electric motors. The system will operate at 250 volts direct current.

Letters From Practical Men.

Numbering and Filing Drawings.

Editor American Machinist:

I have read with much interest the article by S. A. Worcester on "Numbering and Filing Drawings," published at page 557. One of the most difficult problems I have to solve in connection with filing of drawings is naming and indexing them in such a manner that they can be easily found at any future time. This looks simple enough, but with a machine involving thousands of parts, and several draftsmen continually making and naming new parts, many conflictions and misnamed parts will be the result unless they are very carefully watched. For instance, one man will invariably index a screw stud under "Stud," another under "Screw." It is oftentimes a question whether to call a piece a lever or a bell crank; the names gear and pinion are liable to be badly confused, also bracket and bearing. As another instance we use a series of rolls for supporting a reciprocating part, which vary in size from 4 to 8 inches in diameter by about 2 inches face, and are known about the shop as either "rolls" or "wheels."

I have tried to formulate a set of rules which would hold in all cases, but so far have failed, and would be very grateful if someone could suggest a satisfactory plan.

The method of adding a letter to a drawing to denote either the class of machine or location of drawing and size of sheet is at the best confusing, as the drawings will invariably be misplaced, even if only one person is allowed to put them away.

Often one wishes to use a piece which has already been made and used on some previous machine. What is he to do with the class letters, or how is he to get the drawing in two separate drawers at once? Redrawing it for the sake of having a drawing in each drawer and properly numbered is not only expensive, but will sooner or later give trouble and confusion. With the single consecutive numbering system a piece can be used on any number of classes of machines without the least inconvenience, as the number gives no idea of where the piece is used. The title may be made to give this or not, as desired, but the index should always show it as well as the list of part numbers for the machine in question.

It is always policy when designing a new machine to reserve numbers enough to bunch all of the new drawings in one or more drawers, and a few more numbers may be left for additions. This is easily done by reserving space in the drawing number book, and if a few numbers are reserved which are never used, no harm is done. If they are all used and more are needed, the drawings will simply drop into their consecutive place a few drawers

farther on, and are easily found by the index. If for any reason it is desired to place a drawing immediately following some old one, it can be done by giving it the same drawing number and adding a letter. This is advisable when the two are liable to be used in connection with each other; a great many drawings may be added in this way without seriously overcrowding a drawer that is already full. I also find it advantageous, in designing a new machine, to place all of the assembly drawings at the top of the drawer, as they are the ones which will be used the most, and if at the top of the drawer, can generally be found without referring to the index. The drawers may be marked with the style and size of machines which they contain as well as the drawing numbers embraced, this marking being for the convenience of those not closely connected with the drawing-room system who may wish to find a drawing after hours, and it should be remembered that it simply shows where the biggest percentage of the drawings are to be found and that some of those in the drawer do not belong with the machine in question at all.

All drawings should be of the same size, or at the most of only two sizes. When this is done the smaller size should be just half the size of the larger, and an occasional drawer may be divided in the center with a strip of sheet iron, which should only be done as they are needed.

Some assembly drawings will of necessity be larger than the largest size. In such cases use two sheets butted together and numbered consecutively, and, unless made on cloth-back paper, the butted ends should be protected from tearing by pasting a strip of washed-out tracing cloth across the edge.

It is always best to make a drawing on mounted paper if there is any possibility of its being used much, and although the manager will tell you it is too expensive, he does not stop to think that the expense of the paper is nothing in connection with the work expended on it.

There should always be one person whose business it is to put away all drawings. Anyone is allowed to take out whatever he wants, but, when through with it, must leave it for the above mentioned person to put away. This insures a drawing always being in its proper place, or, if not, the person who put it away can be held to account for it. A few such instances of misplaced drawings will teach him to always put them in the right place.

A tracing which is out of date should never be destroyed. When it is wished to alter one which is no longer used, a blueprint should be made and filed in its place (for future reference in case of a repair order), after which the tracing may be altered as desired, always remembering to alter the number or add a letter to it, according to the conditions.

FRED S. ENGLISH.

Boring Sensitive-Drill Frames in the Lathe.

Editor American Machinist:

I send you herewith a photograph of a rig for boring the holes for the spindle and table in sensitive-drill frames. It consists simply of two V-blocks, one of which is fitted to the T-slot in the back of the carriage, and bolted fast, while the other is gibbed to and made to slide on the ways.

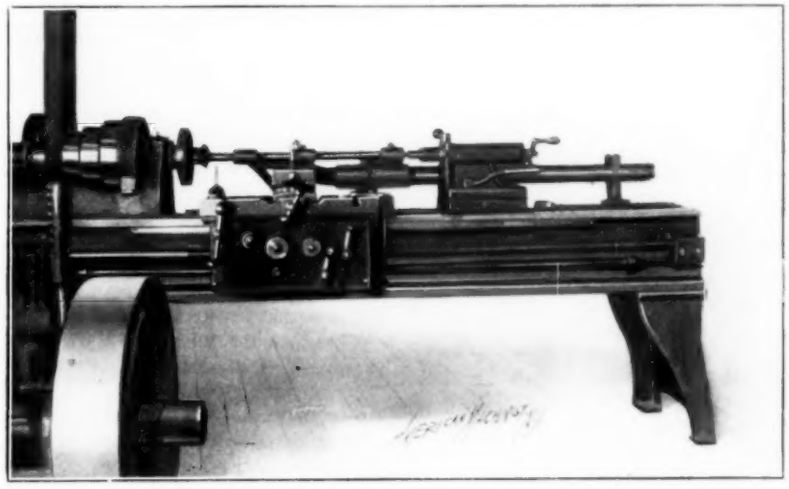
The round column is laid in the V-blocks, which are exactly parallel with the ways, with the lower spindle bearing resting on top of the carriage slide, and clamped to it with a bolt in the tool-post slot. The bearings are bored and faced on both sides with a bar running on centers in the ordinary way, using the regular carriage feed. A bushing fitting the bar is placed in one of the holes to steady the bar while facing. JAMES F. WILLEY.

Jeffersonville, Ind.

Making Molding Sand.

Editor American Machinist:

The article on "Molding Sand," at page 647, has prompted me to tell my experience some years ago in this line, hoping it may prove of as much value to many of your readers as it has to the party by whom I was then employed.



BORING SENSITIVE DRILL FRAMES IN THE LATHE.

Having very little foundry experience, I was suddenly called to take charge of a small foundry that was not working well. One of the first difficulties I met was the poor, or, rather, the improper, quality of the molding sand. It was entirely too fine and close for most of our work. It was a local sand, dug five or six miles away, and no other sand had ever been used in this foundry. The head molder insisted that it was all right, and said the trouble was with the poor quality of mechanics we were employing, and I had to admit that good castings could be made in it by very careful tempering, ramming and venting; but this took time and skill, and these were two of the most expensive items in our foundry accounts.

It was a manufacturing foundry and made but one line of castings and the same pieces over and over all the time, and hence requiring comparatively little skill on the part of the molder, if only his sand could be manipulated more easily. I know that when some of the old-time molders read this they will say that I am decidedly "off my base," but I am not through with my story yet, and I am writing for others besides the class referred to; but they may "catch on" and come along, too.

Well, I wrote to all the foundry supply men and sand men I could hear of and procured several sample barrels of molding sand from as many different parties, which we tried with varying success. But one morning one of our men came in with a small bag of sand on his back, which he had dug in a field about a mile away, which seemed to be very good sand for our work. I went with a team on a tour of investigation and brought back a load of excellent molding sand. The supply, however, proved to be very limited, most of the sand in this and adjoining fields being entirely too "weak" for molding sand, or, to use a more technical expression, it lacked "bond" and would have made excellent very fine masons' sand, the masons supplying the bond in the shape of lime, cement, etc. This suggested to me that we also might supply the bond for molding sand, and having on hand a barrel of ground fire clay, used about the cupola, we tried mixing a little of this with our very weak molding sand, and the result was gratifying. We at once had a very strong, open sand that would not "drop," "scab" or "blow" under ordinary provocation, and bore hard ramming to a degree that surprised us all. The ground fire clay was somewhat expensive, and our next move was to procure a supply of tough blue clay from a deposit nearby and dry and grind it ourselves. This proved equally good, but the process was still too expensive, and we found difficulty in mixing the powdered clay evenly with the sand.

Well, to make a long story short, we finally hit on the plan of dissolving the blue clay in water and wetting the sand with this clay water. We sunk a large barrel in the foundry floor, under the faucet, and filled it with water and blue clay, and after each heat, when it is always necessary to wet the sand, we simply stirred up the contents of this barrel and used enough of the clay water to keep our sand of proper strength. This required but little at each heat, according to the amount of new sand that was added, each man soon learning to gage his own sand heap. If it was too strong it would be lumpy when turned out of the flasks and hard to "cut up," and he would lessen the clay in the water for a heat or two. If the sand became too weak it would be "crumbly" in working about the mold and more bond would be added.

Now, this process would not be easy to start with all new sand, as enough clay could not be added at one wetting to bring the entire lot up to the desired strength; but we started by using the powdered clay and ever after discarded it. However, any molder may start with his present sand heap, adding very weak new sand and clay water at each heat, and gradually the quality of his sand will improve, if the new sand is otherwise right and the clay of proper quality. I believe that the weaker, or, as the masons would say, the "cleaner," the new sand is the better, as the tough, sticky blue clay that is added is a better bond than that of ordinary molding sand, and therefore a less quantity of it is required to bring the sand up to the necessary strength, and hence we may have, in this manufactured article, a sand at once stronger and more open, or porous, than that in ordinary use.

The truth of this theorizing has been abundantly proved in this foundry; for after the introduction of this new-process sand the same castings as before were made with the most careless ramming and with almost no venting, and they came out all right, and this has continued for some half a dozen years, and is now the regular practice.

At one time during our experimenting we procured a quantity of the ordinary "shore sand" of the market and added the bond as described, and the result was satisfactory, except the expense of the sand. I have no doubt that in many places this sand can be procured at low rates and would make a superior molding sand for some kinds of work.

I may add that some of the sand which came to our foundry had a tendency to be gravelly, but even this did not prove a serious detriment, as our reserve stock was kept under cover and the top of the heap was nearly always dry, and in this condition it would run through a very fine screen nearly as fast as a man could shovel it, and thus eliminate the small stones, which would not be the case with ordinary molding sand, as it would not dry out so fast nor so readily go through the screen.

J. C. GREEN.

Hackettstown, N. J.

Men and Things in False Positions.

Editor American Machinist:

The bursting of a 12-inch gun on the "Iowa" when fired for the one hundred and twenty-eighth time, three men being killed and a number wounded, was a costly lesson in gun design, and it may perhaps be made to yield us other lessons of no little value. We can speak of this accident without a suggestion of reproach, for the lesson, so immediately evident after the event, had apparently not been anticipated by any of the experts. No one was to blame, for no one knew any better; and yet undoubtedly the poor gun was "placed in a false position," as we conversationally express it, and if it might be assumed to have had a personality, it was to be pitied and not to be blamed for the lamentable occurrence. So far as appears, it was all right for the work for which it was calculated in the making, but it was given a strange job to do for which it was not fully provided, and its failure was the result of circumstances beyond those initially contemplated. The gun was made for a charge of "brown" powder, which burns in an ascertained way and at a rate which has been accurately determined, but when the explosion occurred the newly adopted "smokeless" powder was used, which burns differently and continues its impelling action longer, so that the muzzle of the gun was subjected to an internal pressure considerably above what it was made to withstand, and it consistently failed. This was a double case of "false position." The gun was imposed upon and gave out. The powder was improperly used, and I suppose its reputation also has to undeservedly suffer.

Guns and gas engines, which belong to the same family, are continually in a false position in the minds of many on account of the popular and widespread misunderstanding of their action, and the accident to this gun calls attention to it. The idea of instantaneousness, or the lack of the element of time, in the explosive action, we may be helped to learn by this case to be erroneous. The projectile is not struck suddenly as by a hammer, but is started and followed up by a pushing force of gas behind it until it is entirely out of the barrel, and this following gas pressure in the gun on the "Iowa" was sufficient to burst the muzzle and rip it to pieces for quite a distance back. The burning of the powder and the generation of the gas may have continued throughout the entire period occupied by the projectile in traversing the length of the gun, and there is evidence that the burning does often so continue in the finding of unburned powder discharged from the nozzle. Supposing the combustion to have been completed before the projectile had reached the end of the gun, it would still have been followed by expanding gas at high pressure, the expansion not reducing the pressure as rapidly as the strength of the barrel fell away through the progressive reduction of its external diameter.

In the case of the gas engine we have in the indicator diagram a clearer story of what takes place. In this also we find that the explosion, or the act of burning the combustible, takes an appreciable and a distinctly measurable period of time, but occurring at such a part of the crank revolution that the work of driving the piston forward is certainly mostly done after the "explosion" is completed. The gas engine, or the oil engine, is not an explosion engine but an expansion engine, and more truly and completely so than a steam engine is. The piston is driven forward by the expansion of the gas in the cylinder, the expansion normally beginning earlier in the stroke or continuing for a much greater portion of the stroke than is usually possible with steam in the steam cylinder.

In the case of the gas or oil engine it might not make so much difference about placing it in a false position either theoretically, as here indicated, or practically by changing its adjustments or by substituting a different combustible or a different proportion of mixture, but in the case of the gun the abnormal conditions entailed serious results. The explosion "for cause" affects the future of the entire gun family of Uncle Sam.

When it comes to the driving of men it is rather essential to be correct in both theory and practice as to the conditions of the driving. No man can be driven at his best, and not always even in safety, if placed in a false position, and it makes little difference whether he has placed himself, has been placed by another or has been driven by circumstances into the false position. Anyway it's a bad thing, and yet the false position is, after all, the most frequent, and the true position the exception. The problem of advancing civilization is the getting of the masses out of false positions.

Many have remarked about the life-long false position of the physician, whose only employment comes from the diseases and bodily derangements of men. While all his income is derived from the practice of his curative powers, he must still be looking, if not wishing, for the opportunities to be as numerous as possible for their exercise. The man who works for daily wages or for a fixed salary is in a false position in somewhat the same way. It is certainly to the interest of the employer, and, in a large view of it, as certainly to the interest of all men, that the worker shall, when working, do all that he can without injury or lasting discomfort to himself. The wage is the inducement, without which no work is done; it is evident therefore that the wage should be so applied as to have a pull upon all the work that is done. Instead of paying for

what is done and apportioning the amount paid so that it shall have some relation to the amount of work that is done, we apportion it according to the time, or, say, the opportunity the man has for the doing, and whether he makes the best use of the opportunity or not he is paid just the same. The new schemes which are proposed as substitutes for the day-work plan are valuable as stimulants to thought upon this important topic, and as indicating, perhaps, the direction in which the better way is to be looked for, which is far enough from any personal acknowledgment on my part that they are of permanent value or that the ultimate solution is in sight. TECUMSEH SWIFT.

The Velocity of Objects Floating in Running Water.

Editor American Machinist:

Can an object floating in running water travel faster than the water? If that question had been put to me a short time ago, I should probably have answered, "No," and my experience with others, whom I have sounded on the subject since my attention was called to it, forces me to the conviction that the general belief on the subject is an erroneous one. For that reason I have thought that the following account of the experiences of an eminent engineer, long since dead, may prove interesting. Recently I was looking over some old volumes of a magazine bearing the comprehensive, not to say pretentious title of the "Mechanics' Magazine, Museum, Register, Journal and Gazette," of London, and ran across an extract from the posthumous letters of Brigadier-General Sir Samuel Bentham, comprising an account of how he was converted, against his original conviction, to the belief that objects of different weight and shape floating in running water travel at different speeds, which are frequently greater than that of the water itself.

Sir Samuel's explanation of the apparent paradox is so clearly expressed that I cannot do better than quote his words, but first I will briefly resume his narrative of the circumstances which served to call his attention to the question.

When he happened to be at a river town in Siberia, he heard the statement made that some iron, which was to be sent down the river, would arrive at its destination sooner if large and heavy barges were employed in place of lighter and smaller boats.

Sir Samuel maintained that it would make no difference in the time whether large or small boats were employed; but he failed to make any impression upon the Russians, eminent engineer though he was, because they said they knew better from experience. Both parties were obstinate, and Sir Samuel left without an opportunity of putting the matter to a test.

About a year later, however, it happened, while he was descending the river Angora, that he noticed that the bark he was in, which was being propelled by the current only, was traveling much faster than the pieces of wood and other debris floating on the surface of the stream. He says, "I was astonished at this phenomenon and presently recollected my dispute with the people at Nigni Faghil." He then proceeded to experiment, embarking himself in a small boat, for one thing, which was rapidly left behind by the larger vessel. The cause of the difference in speed was not in the depth of the draft, for the barge or "bark" was very shallow, being flat-bottomed. He finally reasoned as follows: "Rivers consist of water running down an inclined plane by the force of gravity. Were it not for the resistance the water meets with in the bed of the river, as well at the bottom as at the sides, the water would run down infinitely faster. Bodies floating on this running water are acted upon also by the force of gravity; they have a tendency to move with as great a velocity as that which the water itself would have, had it met with no resistance against the bed of the river. These floating bodies do not touch the bed of the river; their motion is not impeded, until we come to consider the resistance they meet with in the water itself. But they meet with none till their motion exceeds that of the water. Their motion then must exceed that of the water and that the more so the less they are affected by that resistance; hence the better their shape is adapted to divide the water and the greater proportion their gravity bears to their surface of resistance, the quicker they will be impelled by their gravity through the medium which tends to retard their motion. They would acquire, were it not for the resistance they meet with from the water, precisely that degree of velocity which the water itself would acquire, were it not for the resistance it meets with from the land."

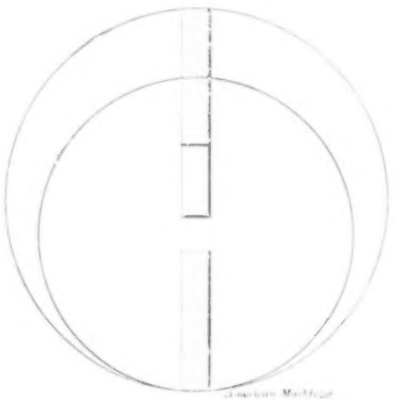
This conclusion is, of course, incontrovertible, and shows that every object floating in running water of sufficient depth would travel at least as fast and generally faster than the average speed of the water itself were it not for the resistance offered by the atmosphere. Could not this fact be taken advantage of to test the relative resistance to passage through the water of yacht hulls of different shapes? Provided their tonnage and draft were equal and that the conditions during the trial were the same for both, the yacht or model (for presumably the tests would be made with models) which had the best lines would show its superiority by forging ahead of the others.

HOWARD A. COOMBS.

[If a wheeled weight were placed upon an inclined plane it would move down the plane regardless of whether the plane were in motion or not. This is substantially the condition of the body floating down stream, and it seems to us the position taken is incontestable.—Ed.]

The Hult Rotary Engine—Erratum.

There is an obvious error in the engraving of the Hult rotary engine given in Mr. Booth's article at page 728. One



THE HULT ROTARY ENGINE.

of the shutters should obviously be extended to the outer circle, as shown in the accompanying illustration.

Enlargement of the Michigan College of Mines.

The Legislature of Michigan has passed a bill appropriating $171,000 for the Michigan College of Mines at Houghton for the biennium beginning July 1 next.

The most important item of this appropriation is that of $45,000 for the construction of a metallurgical laboratory. The college intends to erect a substantial building for this purpose and to thoroughly equip it for experimental work and instruction in the different classes of metallurgical processes.

Cyaniding and other wet methods of concentration will be exemplified in the equipment, and electrometallurgy will receive special attention. It is intended to install furnaces of larger capacity than is usual in college laboratories.

The Board of Control of the college is taking steps to create a separate department of ore dressing and metallurgy. The equipment for this department will be housed in the new metallurgical building and in the ore dressing mill now possessed by the college. A man to fill the new chair has not been selected.

Besides the amount for a metallurgical laboratory, the bill referred to carries an appropriation of $9,000 for extending the equipment of the department of mining engineering which now occupies its new building, erected last year; $4,000 for completing the equipment of the chemistry building, also erected last year; $2,000 for providing additional cases for the mineralogical museum, and $1,000 for increasing the equipment of the department of mechanical engineering.

Consul F. W. Mahin, at Nottingham, England, reports that iron plates are beginning to supersede steel ones for ship construction because they are less subject to corrosion by sea water.

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Department Stores and Improved Machinery.

Press despatches announce that the Retail Grocers' Association of Milwaukee has adopted resolutions to the effect that they will not handle products of manufacturers which are sold or placed on sale in department stores.

Probably it would be a surprise to these grocerymen if they were to be shown that by this action they are doing what is exactly the same in principle as what is done by workingmen when they oppose the introduction of improved machinery or attempt to restrict the output of it. The fact is that the efficiency, so to speak, of the retailing of manufactured products has been improved very little in many years. Manufacturing and industrial operations have been revolutionized time over and again during the time when the retailing of goods has been practically at a standstill, and in most places goods are retailed at as high an expense or at as low efficiency as was the case fifty years ago. Department stores are nothing more than an effort to introduce improved modern methods into the retailing of goods. They are not monopolies in any reasonable interpretation of the word, since anyone who has capital or can join his capital with others can go into the business of running a department store, and there is plenty of capital available for it. Therefore the only principle upon which they can succeed is by retailing goods at a lower cost than can be done by other methods, which is simply another term for high efficiency. It follows inevitably that these grocerymen, by attempting to boycott manufacturers whose goods are sold in department tores, are simply placing themselves across the track of progress in exactly the same way as workingmen do when they attempt tb prevent the introduction and use of improved machinery.

The Largest Producer.

Andrew Carnegie has a way of dropping occasional remarks or expressing opinions that attract attention and have to a preeminent degree that quality which we call common sense. He is reported as having said to an interviewer recently in London:

"You led the world once, but now we have taken your place. You cannot compete with us in industry, and you will be happier if you acknowledge it. Our manufactures are already three times as valuable as yours, and our exports greater. How can you compete with us? The very size of our great industries gives us an immense advantage. By standardization we can supply the demands of the world at prices you cannot think of. You are exhausting your coal and iron very rapidly. Your rate of increase in population must soon begin to diminish. You are already full up. We are only beginning. We have plenty of territory entirely unexplored, where there will some day be a great population. Your colonies are not increasing. Australia seems full. It is a mere rind around an empty interior. South Africa is not a white man's country, and your Government's policy of encouraging emigration there, especially of women, is almost a crime. As for Canada, compare her growth in the nineteenth century with that of the United States. Her only chance of a future is to throw in her lot with the Americans."

Though there is nothing in this but what has been said in one form or another by others many times over, it is being commented upon in some quarters as though it were entirely new, and, after all, what does it mean? We realize what it means when we candidly ask ourselves what difference it makes to an individual producer of iron and steel whether the particular political division of the earth's surface within which his works happen to be located turns out more or less of steel or what not than is turned out in certain other political divisions of the earth's surface. The man in the street or he who has to hustle for a living is no happier or better off because his country produces more goods of a certain kind than another country unless his happiness is found in bragging about it. The prosperity of a given manufacturer is measured by the efficiency of his own plant and methods of doing business, and plenty of prosperous manufacturers can be found in countries whose total products do not stand high upon the list of the world's manufactures. Some of those who are discussing this matter seem to think that as soon as a manufacturer in a given line finds that the products of his country in that line have fallen to second place he should give up and recognize that there is no hope for him. It is true enough that those Britishers who worry about it will be, as Mr. Carnegie says, happier when they make up their minds to acknowledge that America surpasses Great Britain in amount of steel and iron products; but what if it does, and how does that fact alone assume any great importance to the individual producer? If, owing to our supplies of materials or for any other cause, we produce cheaper and can successfully compete in the world's markets, then that of course is significant and may mean much to producers, but even then, so long as Great Britain admits iron and steel free of duty, all her industries dependent upon them may continue to prosper.

The Combination Against America.

The European fanatics who imagine that participation in the benefits of our abundant raw materials and our general and highly developed use of machinery in the production of desirable things ought to be resisted in every possible way, and that Europe must combine to wage a commercial war against us, are by no means having things all their own way, as is shown by the following cablegram from Vienna, dated May 19, and which is as follows:

Addressing a conference of the Austrian

Agricultural Society and the Central Association of Manufacturers to-day upon the formation of an economical union of the Middle European States, Professor Julius Wolf, of the Breslau University, referred to the proposal for an inter-European union against Great Britain and America submitted to the International Agricultural Congress at Rome by Count von Schwerin-Poewitz, on April 18. Professor Wolf did not support the proposal because, he said, Europe feared nothing from Great Britain, agriculturally or industrially, but from the United States everything. He advocated that there be no differential treatment of the United States and no unnecessary provocations, but merely the same treatment of the United States as the latter gave Europe.

In the discussion following on Professor Wolf's address the speakers generally deprecated the idea of attempting to form such a union against America.

A prominent manufacturer, Herr Kuffler, asserted that even the whole of Europe could not successfully combine against the United States, except by force of arms.

By shutting off her exports of cotton, for instance, said Herr Kuffler, the United States could paralyze the European industries.

The Technolexicon.

We have already noticed this very praiseworthy work which is being undertaken by Dr. Hubert Jansen, of Berlin, for the German Society of Engineers, and we revert to it again, as we are in receipt of a report of progress that seems to indicate that the success of the work is already assured. Co-operation has been secured between 42 English and American, 272 German and 27 French technical societies. In addition to this, 2,185 industrial establishments and individuals have undertaken to assist in the work, and up to the present time 207 filled-out note books have been sent to Dr. Jansen, although such books are not to be called in until next year.

This hearty co-operation can be taken to mean only that the need of such an international technical dictionary is widely felt.

We again urge all who feel any interest in the work to obtain one of the special note books, which are supplied without charge, and to jot down the meaning of such technical terms as occur from time to time in connection with work and correspondence. The books may be obtained of Dr. Alfred Muller, 150 Nassau street, New York. There still remains all necessary time in which each may do his part.

No one at all interested in foundry matters should fail to read the letter in another column entitled "Making Molding Sand." Perhaps there are some lines of work for which this combination of clean, sharp sand and clay water would not answer, but it would be decidedly unwise to conclude that it would not do in any given case without first giving it a very thorough trial, and our belief is that in many places and for many lines of work it will prove possible for a foundryman to *make his own molding sand*, and to make it of better quality—*i. e.*, better adapted to his purpose—than that which is furnished by nature, and which must often be transported over long distances. We shall be glad to hear of experiments along this line, and shall hope that many of them will be successful.

Attention is being called to the fact that a very great amount of fire insurance will be called for by exhibitors at St. Louis, and it is expected that as the time of the exhibition approaches the limit of the amount of insurance which the various leading companies will care to write on goods exhibited there will be reached. It will be remembered that there was in some cases considerable difficulty in getting insurance upon goods exhibited at Chicago and at Buffalo, and it will probably be wise to arrange for insurance at as early a date as practicable.

A Prize Offered for Pumping Works.

The Austrian Government offers a series of prizes for lifting pump works to overcome the fall of 39½ meters (about 130 feet) of the Danube-Oder Canal. The aim is to secure effectual navigation by this canal with a minimum amount of water. The method whereby this can be achieved is not restricted to any particular plan. Three prizes, amounting to 100,000, 75,000 and 50,000 crowns ($20,000, $15,000 and $10,000) respectively will be awarded to the best plans submitted. If the plan which will be accepted is given for constructing the work to a party other than the prize-holder, the latter will receive 200,000 crowns in addition. Bids are to be handed in before March 31, 1904. Full description of the work contemplated can be had by applying to the Austrian Legation at Washington, or the Austrian Consuls at New York, Philadelphia, Chicago and San Francisco.

A Splendid Club House for Employees.

The Weston Electrical Instrument Company has recently completed shops at Waverly, near Newark, N. J., which shops are in many respects among the finest to be found in the world. The evening of the 22d an inaugural reception was held at the factory, dedicating to an employees' club a splendid building of large dimensions, three stories high, and which has been constructed and equipped by the company as a place in which employees can take comfort and meet to transact any business of common concern. One floor is provided with cooking apparatus and is to be used as a restaurant. In the lower floor is a very large swimming pool, constructed of glazed tile and cement, there being also numerous marble dressing rooms and many kinds of special baths. The most elegant lavatory arrangements are to be seen here that we have ever seen in a factory for the use of employees. The inaugural exercises included a musical program and an address by Professor Edward Weston, the head of the company, which was replied to on behalf of the employees by A. O. Benecke, chief electrician, and Mr. Weston was presented with an elegant silver loving cup. In his address Mr. Weston stated that the management of the affairs of the club was to be entirely in the hands of employees, his remarks illustrating the exceptionally broad and liberal view taken by him of the relations which should exist between a modern employer and those employed by him.

The Problem of Work and Wages.

If the managing owners and officials of great corporations could only be known to their men, and, equally important, their men known to their employers, and the hearts of each exposed to the other, as well as their difficulties, we should have in that troublesome field such harmony as delights us in the domestic. It is mainly the ignorance of contending parties of each other's virtues that breeds quarrels everywhere throughout the world, between individuals, between corporations and their men, and between nations. "We hate only those we do not know" is a sound maxim which we do well ever to bear in mind. In the progress toward more harmonious conditions between employer and employed we see that the system of payment by fixed wages has been largely supplanted by payment according to value of service rendered by workmen in positions of authority over others, and by recognition not only in money but in position, which often counts quite as much as coin, and not seldom much more with the ablest. There remains still receiving the fixed wage the great mass of ordinary workmen—but we see in the history of relations of employer and employed that these have not failed to rise greatly also. The movement tending to improve the position of the worker has not passed over even the humblest, but has reached and benefited all.

But the irresistible pressure which has forced change after change in the relations of capital and labor still operates unchecked—a sure indication that the final stage has not yet been reached. We have evidence of this in another important advance, the sliding scale, which provides not a fixed wage, but in some degree settles by results. Increased demand brings higher prices and profits to the employer, which in turn bring higher returns, so that as the employer's profits rise and fall, so do the workman's rewards. If I were asked what was the best service the Carnegie Company was ever able to ren-

der the wage earners, next to giving steady employment at wages equal to any, I should answer, "By persuading them to adopt the sliding scale, with a minimum insuring living wages, at its works at Braddock, fourteen years ago, which has given perfect satisfaction from that day to this and is still in force, and has produced undisturbed harmony between capital and labor."

Gentlemen, while, as you have seen, the Carnegie Steel Company interested its young men as partners, and was always anxious to reward exceptional service, and carried the bonus system to an extent, perhaps, unknown in any similar organization, the masses of the ordinary workmen could not be embraced under the limited partnership form, even if it had been thought desirable that their savings should be so invested. The objection to this from the point of view of the workmen, which always arose in our minds, and which we were never able to surmount, was the sad and instructive history of the largest manufacturing concerns, especially those of iron and steel.

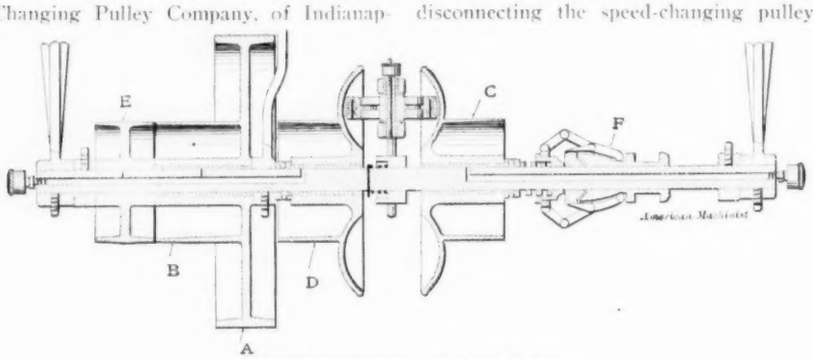
The most convincing proof of the steady march of labor to recompense more and more based upon profits, and in forms drawing capital and labor into the peaceful bonds of mutuality, is to be credited to the United States Steel Corporation, the largest of all industrial corporations, and for which it deserves unstinted praise, as proving a genuine interest in the workmen and sagacious thought for its own.

To this step I invite your earnest attention, for it may well prove of surpassing importance and mark an epoch in the history of the relations of capital and labor. It may even be looked back to as having furnished the solid foundation for the solution of most of the troublesome questions between them.—*From Andrew Carnegie's address before the Iron and Steel Institute.*

Some New Things.

PLANER COUNTERSHAFT WITH SPEED-CHANGING PULLEY.

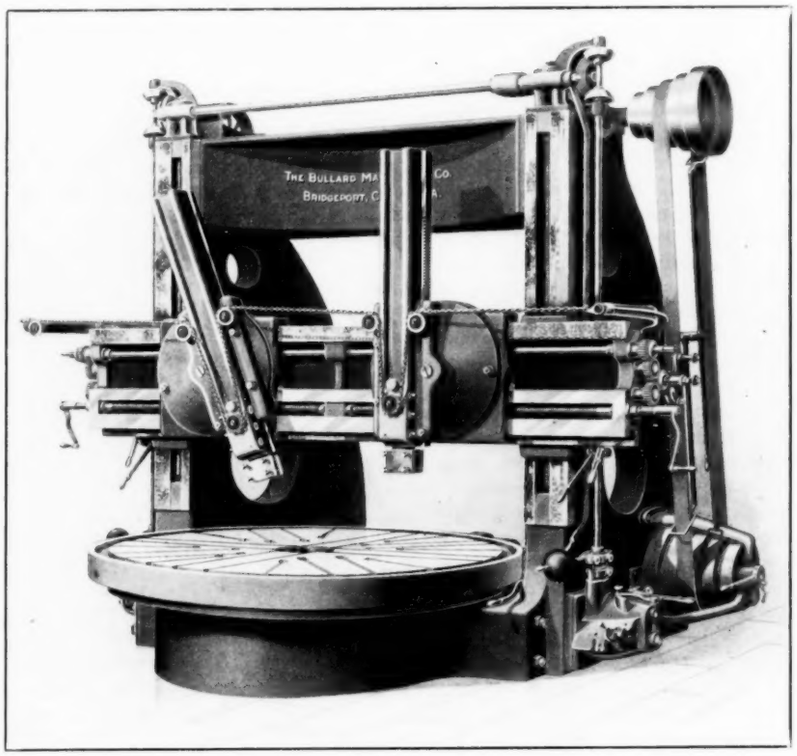
This countershaft is built by the Speed-Changing Pulley Company, of Indianapolis, Ind., and fitted with their variable speed pulley, with which our readers are already familiar. With this counter the speed of the platen on the cutting stroke may be varied to suit the work; the return speed is constant, the reversing belt being driven from pulley *A*, which fits freely on the shaft and is driven from the main line by a belt on the step *B*. The countershaft itself remains stationary, set screws securing it in its hangers. The belt for driving the speed-changing pulley runs on *C*, the latter transmitting power to pulley *D*, from which pulley the planer is driven forward through three shifting intermediate members, only one of which is shown in the cut. The speed of the pulley is changed in the usual way through worm-gearing controlled by a rod and hand-wheel. One shipper starts and stops the various parts mounted on the shaft, this shipper running the belt onto or off from loose pulley *E* and operating the clutch *F* for engaging or disconnecting the speed-changing pulley. The shaft is drilled out from each end, as shown, and grease cups are provided for lubricating the running parts.



SECTION THROUGH COUNTERSHAFT.

10-FOOT BORING MILL.

The boring mill shown in the illustration has been designed to meet the requirements of the new high-power steels, the chief manifestation of this adaptation being the great weight—80,000 pounds.



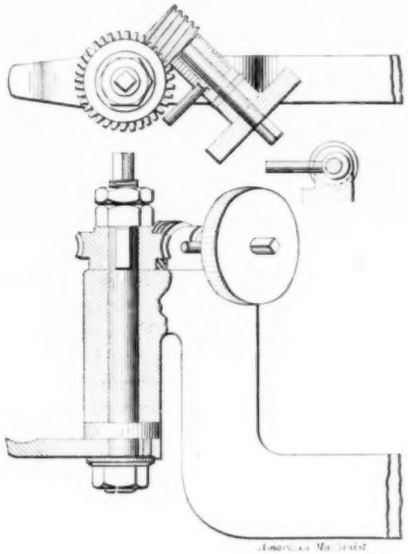
10-FOOT BORING MILL.

Special attention has been given to the adaptation of the machine to belt or motor driving—the latter by either constant or variable speed motor. For a constant-speed motor the countershaft is retained, the motor being attached to the frame on the side opposite to the one shown, a belt connecting the motor to the countershaft. For a variable-speed motor the countershaft and cone pulley are removed and the motor is attached in the place occupied by the lower cone pulley in the machine shown. Belt shippers are provided for shifting the cone belt, these shippers being operated alternately as the operator would do with a small belt when using his hand direct. A wide high-speed belt may thus be shifted with practically the same ease that a controller handle would be manipulated. The heads and crossrail are handled for quick traverse by power taken from the countershaft in the machine shown, or from an independent motor with variable-speed motor drive. Fifteen changes of speed are provided. The feeds—all positive—range between 1-32 and 1 inch horizontally, and 3-128 and ¾ inch vertically. All threads between 1 and 12—including 11½—may be cut by the right-hand head. The changes from feed to screw cutting, from feed to quick traverse and the reversal of feed and traverse are all made by the permanent handles shown.

The weight of the tool heads is carried on the supplementary guide surface, near the bottom of the crossrail, the top guide resisting the tilting action only. The table and spindle weigh together 9 tons, the spindle being 20 and 14 inches in diameter by 60 inches long and the lower bearing being self-contained. The ring table support bearing is 50 inches in diameter, and is flooded with oil. The table is surrounded by an oil channel, the T-slots inclining toward the center with a drain pipe to carry away all lubricant supplied to the tool. The machine requires an 18 horse-power motor.

A SPECIAL LATHE TOOL.

The cut, from a recent patent, shows a lathe tool designed for turning circular concave outlines such as rounded grooves and fillets of considerable radius. The construction of the tool requires no explanation, except to note that the worm spindle is carried through an eccentric sleeve, and

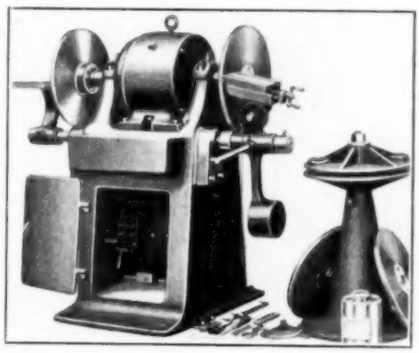


A SPECIAL LATHE TOOL.

by turning this sleeve, which is done by the pin projecting at the side, the worm is thrown in or out of gear. The cut suggests the making of a handy tool for many purposes without the worm gear or any rotating arrangement. The tool could be easily clamped and set at any angle horizontally and the goose-neck holder would prevent chattering.

MOTOR-DRIVEN DISK GRINDER.

This machine, which is fitted with 18-inch disks, and swing tables, one of which is adjustable to any desired angle and provided with T-slots for holding gages or fixtures, is driven by an Akron multipolar, compound-wound motor, the armature being pressed on to the disk spindle. The motor, it will be noticed, is entirely enclosed; the upper portion of the hood may be readily removed, however, when necessary to adjust the brushes. The end thrust of the spindle, or armature shaft, is taken up by jam-nuts placed at both sides of the left-hand box, this arrangement preventing crowding of the nuts against the boxes when the armature becomes warm. The journals are well



MOTOR DRIVEN DISK GRINDER.

protected from dust and provided with ring oilers. The grinder is built by the Ransom Manufacturing Company, Oshkosh, Wis.

Technical Publications.

"Traité de Technoligie Mécanique Métallurgique." By A. Ledebur, Professor at the Academy of Mines of Freiberg, Saxony. Translated into French from the second German edition by G. Humbert, engineer-in-chief of bridges and roads. 740 pages, 6½x10 inches; 729 illustrations. Paris: Gauthier-Villars, 55 Quai des Grands-Augustins.

The superior lucidity of scientific French to scientific German brings this book one step nearer to English-speaking readers than before its translation. In point of gravity it suggests French rather than German authorship, being a descriptive volume of encyclopedic character rather than a profound treatise. Indeed, the author disclaims intention of producing the latter, but has been desirous of writing a book which will aid students and young mechanics in completing their studies and give them an idea of the things they see before them in industry. With this object in view, the treatment is based on an explanation of natural laws and properties of metals. The ground covered is extensive, comprising, in chief, the following topics: Metals commonly employed and their alloys; small tools; work by fusion; work by forging; work by separation (machine tools, etc.); work of combination (riveting machines, brazing, etc.), and works of preservation and embellishment. Then there are chapters devoted to the manufacture of sheets, wire, type, tubes, screws, cutting tools, nails, coins, steel pens, pins, needles, locks, etc. There is a 21-page appendix by M. J. Joly on the safety of workmen, which contains many practical and suggestive rules intended to prevent shop accidents. The dangers of different sorts of machinery are here classified.

The publication of indexes, digests, etc., of current periodical literature is by no means a new idea. One of the latest ventures in this line has been made by the Association de la Presse Technique, 60 Rue du Nord, Brussels, Belgium. This company proposes to issue a series of classified indexes on various topics and has started with the April number of an "Index of the Technical Press." This is intended to give the title, with brief explanation, name of author, origin, date and length of articles of general interest from engineering papers throughout the world. This is printed in French, German and English, titles from papers in other languages being translated into one of these three. The subscription price to the index is $1 a year. Several other features are connected with the publication, such as suggestions for cutting out and gumming selections from the index on cards, and a clipping service by which the original articles may be obtained through the association.

"The Gas Engine Handbook." Fourth edition. By E. W. Roberts. 264 3½x5-inch pages with 40 illustrations. The Gas Engine Publishing Company, Cincinnati, O.

This is a manual of design dealing especially with American practice. European practice in the design of gas engines is quite well treated in existing books, but American practice, which differs from European in important respects, has not been well treated in print. The present volume, while small, contains a surprising amount of information. This edition contains additional matter on automobile engines and a few other additions have been made.

The Norton Emery Wheel Company has republished, in pamphlet form, the article by Charles H. Norton, which appeared at page 185, and with it is published our editorial comments upon the same. This pamphlet, we understand, is gotten out for general free circulation and will be sent to anyone who requests a copy of it. It is especially valuable to those who study, or who ought to study, grinding problems.

A Novel Cause of Death.

A wide belt with a gentle incline, and more or less yielding under pressure, is not the worst place that could be imagined for a tired man to drop down on for a nap. At Windsor, Canada, opposite Detroit, a fireman in an electric power house tried it recently, with fatal results. He dropped down on the belt about midnight, knowing it was usually started about 6 in the morning, and soon was asleep. Some derangement of the machinery caused the belt to be started suddenly about 1 o'clock, and the man was dragged, feet first, between the belt and the pulley. He was shockingly hurt and died in a few hours.

A Nine-Hour Day.

Our contributor W. H. Sargent, who is a draftsman in the establishment named, sends us the following from a news dispatch: "One thousand men are jubilant to-night over the announcement that the scale factory of E. & T. Fairbanks & Co. will adopt a nine-hour basis June 1. It has always been a source of pride that there has never been any strike or labor contest in the scale factory since it was established more than sixty years ago."

After being on strike for about six months, the boilermakers of the Union Pacific Railroad are to return to work pending a settlement of their difficulties by arbitration.

The Executive Committee of the Railway Supply Men has issued a circular explaining transportation and hotel arrangements for the meetings of the American Railway Master Mechanics and Master Car Builders to be held in Saratoga June 24 to July 1, inclusive. Copies of the circular can be had on application to the secretary, J. Alexander Brown, 24 Park place, New York.

The Remington Typewriter Company, of Ilion, N. Y., has announced that it will hereafter and until further notice give $100 a year to each of its employees who has been connected with the company ten years or more, paying $50 on June 1 and the same amount at Christmas. The arrangement is revocable at the will of the company, and is conditional upon good and faithful work in each individual case. As soon as the other employees complete the ten years of service they become beneficiaries with the rest. At the present time 257 are said to be qualified.

What is said to be the largest single boiler ever made has recently been built for a French torpedo boat. It is a water tube boiler and supplied steam for an engine which developed 3,500 horse power. Allowing 12½ pounds of steam per indicated horse-power per hour, the evaporation would be 20 tons of water per hour, while the weight of the boiler complete with fittings is only 19.2 tons, or less than 13 pounds of boiler weight per horse-power developed.

Personal.

Marshall W. Hanks will represent the Nernst Lamp Company, of Pittsburgh, Pa., at the National Electric Light Convention, to be hold in Chicago, May 26, 27 and 28, 1903.

E. O. Edson has been elected secretary and treasurer of the Laufketter-Bendit Mercantile Engineering Company, of St. Louis, Mo., and F. C. Laufketter retires to become president of the Victor Manufacturing Company, of the same city.

T. L. Loose, who held the position of machine shop foreman with the Bullock Electric Manufacturing Company, Cincinnati, resigned May 9 to accept the position of general foreman with the Jenney Electric Manufacturing Company, of Indianapolis. The associates of Mr. Loose at the Bullock Company presented him with a handsome silver tea set, appropriately engraved, as a token of the esteem in which he was held.

Obituary.

Benjamin F. Jones, for many years head of the Jones & Laughlin Steel Company, died May 20, seventy-nine years old. Mr. Jones had been one of the foremost contributors to the development of Pittsburgh, and was as active in political affairs as in business, having been chairman of the Republican National Committee in the Blaine campaign.

Commercial Review.

NEW YORK, Monday, May 25, 1903.

The situation in the machine tool trade continues to be marked by a steady undertone, with the buying of a few tools at a time the distinct feature. This manner of purchasing seems to be increasing in popularity, for more of it has been done during the past few months that we have had occasion to note in some time. This is particularly true of large propositions. Time was when specifications for all the tools required were sent out to the trade at once, but nowadays it is not an unusual thing for the specifications to be issued calling for a few tools at a time. In trade circles the custom is said to be due to the fact that improvements in machine tools are being made so frequently that buyers want to be in a position to avail themselves of them, hence their practice of appearing in the market at occasional intervals.

If there is anything more than another which insures the permanence of the machine tool industry it is the improvements which are constantly being made in it. These are being made with such frequency that the machine tool of a few weeks or months ago loses its identity in one or more ways. We are led into these reflections by some reports which have recently reached us concerning the present condition of the American machine tool trade abroad.

Everybody knows that during the past few years, and especially during the past year, American manufacturers have paid little or no attention to foreign fields, contending all along and now that they have enough domestic business on hand, and see sufficient in prospect, to render it unnecessary for them to go in search of foreign trade.

How long this condition will prevail cannot be surmised, but one of the reports which came to us recently was to the effect that when American manufacturers do turn their energies abroad they will be surprised to see the close resemblance European machine tools bear to their own, and which will make it impossible for them to secure the business they anticipate.

Local machine tool men take no stock in such claims. While admitting that foreigners have been very active recently in copying our tools, they ridicule the contention that they will ever be able to do it to such an extent as to make it impossible for them to obtain orders abroad if they should try to do so. Their principal reason for this conclusion is that American supremacy in machine tool construction is still potent, and that in the matter of improvements Uncle Sam will continue to lead the world. They argue, therefore, that by the time the foreigners have made their tools conform to the latest improvement they have instituted, another one will probably have been effected. Consequently, they assert, they can be relied to hold their own in any part of the world when it comes to offering the best tool that can be had in the market.

The old saw that "it's an ill wind that blows nobody good" was confirmed on Friday, when the repair shops of the Seaboard Air Line in Portsmouth, Va., were completely destroyed, at a loss amounting to at least $750,000. This means a good order for machine tool men when they are rebuilt.

The semi-annual meeting of the National Machine Tool Builders' Association will be held at Worcester, Mass., on Tuesday and Wednesday, June 9 and 10. The machine tool men in Worcester will endeavor to do everything they can for the comfort of those who will attend, and have appointed a committee, consisting of E. W. Whitmore, of the Prentice Brothers' Company, and Enoch Earle, of P. Blaisdell & Co., with that object in view.

When the association met in Cleveland last October it served to bring personally together many men in the trade who had only known one another through the medium of correspondence. It was noticed, however, that the representation from the East was not as large as was expected, chiefly because of the great activity which prevailed at the time, and which made it impossible for many to get away, particularly since the trip to and from Cleveland covered almost two days.

The probabilities are, however, that at the forthcoming meeting of the association the delegation from this section will be considerably larger, since Worcester can be reached from New York in a few hours, and it being summer trade is not likely to be so brisk. No definite announcement has been made of the business to be considered at the meeting.

The Becker Name Plate Company, 245 Atlantic avenue, Boston, Mass., state that business is not only holding up in their line but is increasing, as last month their

business was 25 per cent. greater than the corresponding month of last year.

The Evans Friction Cone Company, 85 Water street, Boston, Mass., say that the outlook for a continued good business in their line is very encouraging and that they are very busy. Mr. Evans states that they are making quite a number of improvements in their friction cone pulleys, and that they are now remodeling their entire line and making new patterns throughout.

The Titusville Iron Company, of Titusville, Pa., has recently completed what is probably one of the largest boiler shops in the country, in being one room 200 feet in width and 425 feet in length, consisting of four 50-foot bays, each of which is equipped with an electric crane of suitable capacity running the full length of the building. Across one end of the building extends the railroad track, upon which railroad cars are run into the works and loaded or unloaded under either of the cranes as desired. A large number of new tools have been recently purchased. This company has enjoyed a very desirable trade in the horizontal tubular boiler and all classes of sheet iron and heavy plate work.

The American Blower Company, of Detroit, Mich., reports business excellent in all of its lines. Among the larger orders recently received they mention heating and induced draft apparatus for the new plant of the Ironton (Ohio) Engine Company; drying apparatus for the Illinois Sugar Refining Company, to be installed at Pekin, Ill., and dry kilns for the Mengel Box Company, of Louisville, and the Brooklyn Cooperage Company, of New York.

The Tabor Manufacturing Company, of Philadelphia, announces that it has arranged with the Draper Company, of Hopedale, Mass., for the manufacture and sale of hand-rammed molding machines, which the latter firm has been building for its own use. This machine will go into places and be used for lines of work for which it is specially adapted, either in connection with or independently of the Tabor molding machine.

The Christensen Engineering Company, of Milwaukee, Wis., manufacturers of air brakes and "Ceco" electrical machinery, will hereafter be known as the National Electric Company. The constantly increasing demand for Christensen air brakes and "Ceco" electrical machinery has made the change of organization necessary. To accomplish this result the owners of the stock of this company have organized the National Electric Company, and the assets, good will, etc., of this company have been transferred to the National Electric Company; the purposes, ownership, management and control of the new company are identical with those of the old.

The New York office of the Plunger Elevator Company, 156 Fifth avenue, has closed a contract for two of the latest types of plunger elevators to be installed in the New York Maritime Exchange.

The Loomis-Pettibone Company, of 52 and 54 William street, recently increased its capital to $2,000,000. The officers and directors of the company are: Benjamin Guggenheim, president; Cyrus Robinson, first vice-president and general manager; Burdett Loomis, Jr., second vice-president and manager sales department; Leon P. Feustman, secretary and treasurer; Burdett Loomis, Sr., consulting engineer; Hawley Pettibone, chief engineer; Charles E. Finney.

The new plant of the company is now under construction at Elizabeth, N. J., and will be provided with the best modern equipment for turning out work of the highest grade. The company expects to spend in the neighborhood of $600,000 on this plant immediately, and it will be so designed as to permit of expansion as fast as conditions demand. The company is now prepared to enter into contracts for the equipment of complete plants, gas generators, gas engines, and electric generators and motors. Until its own plant is ready to turn out large gas engines they will deliver the engines manufactured by Crossley Brothers, Limited, of Manchester, England, of which they have the exclusive agency for North America, and for which they have recently secured some very large orders.

The Toledo Machine and Tool Company, of Toledo, Ohio, has outgrown its present quarters and has just let the contract for a new shop building, which will be 100x262 feet. A portion of this building will be five stories, the balance two stories. The managers of the company have visited many of the best modern shops in the country for the purpose of getting full information concerning modern machine shop methods, and they believe when their new shop is finished it will be one of the most perfect and best equipped shops in the United States. The new shop will have a 30-ton 40-foot span electric travelling crane, with a 150-foot runway. During the past four years the company has been gradually disposing of its old machine shop equipment, replacing same with the best machine tools on the market, and orders already have been placed for a large amount of new equipment to be installed in the new shop. Industrial railways, pneumatic hoists and overhead trolleys are some of the features to which special attention has been given.

The contractors are under bond to have the new building completed by July 25. A large portion of the new equipment is now on cars at Toledo, and the company expects to be doing business in its new quarters by August 15, when the present capacity will be more than trebled. It is possible that the capital stock of the company will shortly be increased to a quarter of a million dollars to enable the company to handle its increased business.

CHICAGO MACHINERY MARKET.

When trade conditions are inquired about at the office of a Western dealer in machinists' supplies of almost any kind the chances are that strikes, actual or prospective, will be the first topic that will be voluntarily mentioned by the manager. The labor situation has thus become one of the market factors. The usual statement heard is that business on Canal and Clinton streets, Chicago, and in that neighborhood has been seriously curtailed. Thus a teamster, who does hauling for many of the machinery houses and has twelve teams, says he now has work for only four of them.

But in regard to the trade in machinists' supplies it makes a difference whether or not the buyers are mainly the manufacturers or the men. One shrewd supply house man observes that a strike in a machine shop usually means a boom in the small machine tool trade. He explains the anomaly by saying that when the men are idle they have time to visit the supply stores and find out what is new. They invariably find something newer or better than they have been using, and rarely leave the store without making a purchase. It often happens, likewise, that on occasions like that machinists frequently change from one shop to another and have a new line of work to follow, which necessitates some tool purchases. And there is also to be considered the improvident class of men, who, when idleness comes, are obliged to sell or pawn their tools, resumption of work obliging them to purchase anew.

There is a difference also between the trade that comes from jobbers and from retail merchants and that which comes direct from the manufacturer. It takes some time for adverse shop conditions to impress the merchant trade. The general opinion, based upon trade up to the present, seems to be that May will show a slight decrease in its totals from April, which was an unusually good month. And the pessimistic talk that is in the air relates more to the future than to the past or even the present.

It is one of the pleasing statements that the idleness, actual or prospective, is not occasioned by any lack of orders or business. The common report is that the state of the trade is excellent, many shops having contracted their output for a considerable period ahead. There is a present lull, induced by newspaper discussion quite largely, but while it lasts it unfavorably affects the aggregate volume of trade, even in the shop supplies.

C. H. Besly & Co. report an undiminished call for Gardner grinders, Helmet temper taps and other specialties of their manufacture. The Baldwin Locomotive Works are a recent buyer of a large Gardner grinder.

Quotations.

NEW YORK, Monday, May 25.

New York prices for Northern and Southern irons for nearby delivery are as follows:

Northern:

No. 1 X	$20 50	@	$20 75
No. 2 X	19 50	@	19 75
No. 2 plain	19 25	@	19 50

Southern:

No. 1 Foundry	20 25	@	20 75
No. 2 Foundry	19 75	@	20 25
No. 3 Foundry	19 00	@	19 50
No. 4 Foundry	18 00	@	19 00

Bar Iron—Base sizes—Refined brands, mill price on dock, 1.85c. upward in carload lots. Smaller quantities from store, 2.00 to 2.15c.

Tool Steel—Base sizes—Good standard quality, 7c.; extra grades, 13c. and upward.

Machinery Steel—Base sizes—From store, 2.05@2.10c.

Cold Rolled Steel Shafting—2.90c. from store for base sizes.

Copper—Lake Superior ingot, 14¾ @ 15c.; electrolytic, 14¾ @ 15c.; casting, 14½ @ 14¾c.

Pig Tin—In 5 and 10-ton lots, f. o. b. New York, $28 30 @ $28 50.

Pig Lead—4.37½c. for carload lots.

Spelter—5.60 @ 5.75c.

Antimony—Cookson's, 7⅝ @ 7⅞c.; Halletts, 6¼ @ 7c.; other brands, 6½ @ 6¾c.

Lard Oil—Prime City, 77 to 80c., according to brand and quantity, ranging from one barrel up to large lots.

New Catalogs.

Kerr Brothers Manufacturing Company, Toledo, Ohio. 1903 catalog of handles, tools, hard and soft wood lumber, electrical supplies, tent materials, etc. 6x9, pp. 16, paper.

B. F. Goodrich Company, Akron, O. "Goodrich Clincher Tires," a pneumatic tire for vehicles, describing the tires and method of attachment and giving instructions for the making of repairs. 6x9, pp. 36, paper.

Dodge Manufacturing Company, Toronto, Ont. Power transmission machinery, including wood split pulleys, rope transmission, friction clutch and cut-off couplings, grain-handling and conveyor machinery, etc. Profusely illustrated. 6x9, pp. 311, paper.

American Blower Company, Detroit, Mich. "The Heating and Ventilation of Manufacturing Establishments." Containing a number of half-tone illustrations of plants in which the "A B C" fan system has been installed. Attractively arranged and printed. 7x9, pp. 32, paper.

Dodge & Day, Nicetown, Philadelphia, Pa. "The Requirements of Machine Tool Operation with Special Reference to the Motor Drive," reprint of paper by Charles Day presented at the two hundred and twenty-ninth meeting of the New York Electrical Society, December 17, 1902.

Goodell-Pratt Company, Greenfield, Mass. Catalog No. 6, representing a large line of tools, including automatic screwdrivers, hand, breast and bench drills, chucks, hack-saws, saw blades, polishing and grinding heads, glass cutters, tool sets etc. Profusely illustrated. 6x9, pp. 128, paper.

Jeffrey Manufacturing Company, Columbus, Ohio. The "Barney" brick conveyor system. A neatly printed and well illustrated catalog of brick handling methods, containing also descriptions and views of other conveying systems and specialties of the Jeffrey Manufacturing Company. 6x9, pp. 32, paper.

Fort Wayne Electric Works, Fort Wayne, Ind. "Perfection in Transformer Insulation." This publication contains information in general on transformer insulation and describes in detail the process of treating coils for transformers of the make of the above company. 5x8, pp. 15, paper.

The Garvin Machine Company, Spring and Varick streets, New York. "Universal Milling Machines," Catalog No. 1, 1903. Five sizes of milling machines are illustrated, together with fittings and parts. Special attention is devoted to the No. 2½ universal machine, which is illustrated in several positions and described in detail in the text. 6x9, pp. 31, paper.

The Solar Motor Company, Boston, Mass. Solar motors, devices employing the heat of the sun for fuel, for generating of power and heating of water. Illustrated by photographs. 6x8, pp. 12, paper. "Solar Generators and Hydraulic Engines," paper read by Wm. Henry Jaques before the Tenth National Irrigation Congress, Colorado Springs, October 6 to 9, 1902.

American Air Compressor Works, 26 Cortlandt street, New York. Air compressors; Catalog "A." American air compressors, air receivers, vacuum pumps, carbonic gas and high-pressure compressors and American air lift pumping system, together with information regarding pneumatic tools, including a table showing flow of air through various sizes of orifices. 6x9, pp. 54, paper.

The Pike Manufacturing Company, Pike Station, N. H. "Oil Stones; How to Use and Select Them." A 30-page booklet giving suggestions on the selection, use and care of oil stones, containing also a brief account of the sharpening stone in history and of its development from the crude stones used by the ancients to the fine oil stones in use to-day. This booklet will doubtless interest those having to do with the use and purchase of sharpening stones.

The Safety Emery Wheel Company, Springfield, Ohio. Emery wheels and grinding machinery; safety, sectional, plain and special corundum, carbondite and emery wheels, and a varied line of grinding and polishing machinery, including open side surface grinders, automatic disk grinding and polishing machines, plow grinding machines, tool grinders, combination grinders, etc. Profusely illustrated by half-tones and drawings. 6x9, pp. 172, paper.

The Binsse Machine Company, Newark, N. J. "The Tool for Quick and Accurate Boring." This catalog illustrates three sizes of horizontal boring machines and shows a number of views of the horizontal boring machine operating on representative work. Boring bars, boring head, facing attachment, rotary tables, etc., are also shown. The machines and attachments are fully described and illustrated, the illustrations being of a high order. 5x7¾, pp. 31, paper.

De Laval Steam Turbine Company, New York. The De Laval steam turbine; its superiority in point of efficiency and economy to ordinary types of steam engines; its construction and application in steam turbine motors, direct-connected steam turbine dynamos, steam turbine pumps, electro-motor pumps, steam turbine blowers, marine lighting sets, rotary fire engines, etc., described and illustrated. Illustrated throughout with reproductions of drawings and photographs. 6x9, pp. 52, paper, with attractive cover design.

New York Belting & Packing Company, New York. "Mechanical Rubber Goods." This is a handsome catalog, printed and decorated in colors, showing some of the products of the above company, including rubber belting, packing, matting, hose, tubing, rubber covered rolls, interlocking rubber tiling, etc. It gives some interesting information regarding the history of rubber, its production and utilization. It is profusely illustrated with fine half-tone cuts and decorative drawings, and bears an attractive illuminated cover design. 5½x8½, pp. 89, paper.

Western Electric Company, Chicago, Ill. "Power Motors." Showing types of motors adapted to driving various classes of machinery. Besides detailed descriptions and illustrations of the motors, a number of photographs are reproduced showing their application to machines. Attractively arranged and printed in two colors on coated paper. 7¾x10¾, pp. 54, paper. "W. E. Fan Motors" describes and illustrates in detail various types of electric fans, motors, accessories and parts. 7½x10½, pp. 55, paper, with handsome cover design.

The Cincinnati Planer Company, Brighton Station, Cincinnati, Ohio, 1903. Catalog of metal working planers. In addition to a line of standard planers in sizes from 24 inches up to 60 inches special sizes of widened planers are shown. Motor-driven planers and a special rack-cutting planer are also illustrated, besides fittings, planer tools, chucks, centers, nuts, jacks, etc. Complete instructions as to the erection and care of "Cincinnati" planers are given. The illustrations are all from photographs and are notably fine, and the descriptive text is clear and concise. 6x9, pp. 44, paper.

H. B. Underwood & Co., Philadelphia, Pa. Portable tools for railway repair shops, comprising portable cylinder boring bars and fixtures, portable valve seat rotary planing machine, locomotive cylinder or dome facing machine, portable milling machine, portable crank pin turning machine, radius planer attachment, eccentric mandrel turning machine, etc. The catalog is well illustrated and neatly arranged, and it will be very acceptable to those interested in the use of portable machines of this class in railway repair shops and locomotive and engine shops in general. 6x9, pp. 35, paper.

"New York to Newfoundland. Thirteen Days on the Steamer," by Marion Varian, associate editor of *Compressed Air*. The author tells of personal experiences and observations on the trip. The booklet is replete with vivid word pictures and illustrations from original photographs, making it a veritable guide book. So effective is it from an advertising standpoint, and so entertainingly are described the enjoyments of life on board ship, the varieties of scenery *en route*, the inland excursions to points of interest, and, in fact, all the characteristic features of this trip, that after reading the booklet one feels like packing his grip and starting off for Newfoundland. 3½x6, pp. 44, paper, with attractive cover design.

The R. K. Le Blond Machine Tool Company, Cincinnati, Ohio. Milling machines, plain and universal, with attachments, accessories and parts. In this catalog is shown the line of milling machines, as redesigned in 1902, now being built by the above company. The detail and general design of the machines are shown by representative drawings and excellent half-tone illustrations, and the construction and principal parts of each machine illustrated are fully described in the text. Tables of speeds and feeds of No. 2 back geared universal milling machine are given. The catalog also contains directions for erecting, adjustment and care of milling machines. It is attractively arranged and printed on coated paper. 6x9, pp. 73, paper, with cover design in colors.

The Warner & Swasey Company, Cleveland, Ohio. 1903 catalog of "Machine Tools for Iron and Brass Work," containing a varied

line of turret machinery, including hollow hexagon turret lathe; forming turret lathes, with specimens of forming turret lathe work; universal turret lathes, including a new 24-inch universal turret lathe especially adapted for the manufacture of iron and brass valves and for a large variety of standard machine parts; valve milling machines, double-headed key lathes, vertical turret machine, turret screw machines, etc. Complete descriptions with dimensions of sizes are given, and the machines are well shown in whole and in detail by carefully selected photographs. The catalog is printed on coated paper and bears a neat and attractive cover design. 6x9, pp. 59, paper.

Niles-Bement-Pond Company, 136 Liberty street, New York. Multiple drills. This catalog shows an exceptionally fine line of multiple drilling machinery designed for regular and special work. The machines are divided into four groups. The first shows the Pratt & Whitney design of gang drills and four types of adjustable multi-spindle drills for drilling simultaneously a number of holes in valve flanges, electric car motor frames, automobile hubs, etc. The next group of machines are standard and special multiple drilling machines of Niles-Bement design. The next section shows a line of multiple drilling machines of Niles-Bement design for railroad work. Among these are a four-spindle mud ring drilling machine, locomotive frame drilling machine, rail drilling machines, arch bar drilling machines, four to twenty-seven spindle car wheel drilling machines, and extra heavy locomotive rod boring machines. The last section illustrates universal drilling and boring machines of Bement design. The catalog is well printed on coated paper and fully illustrated by reproductions of photographs. 9x12, pp. 47, paper, with attractive and appropriate cover design.

Niles-Bement-Pond Company, 136 Liberty street, New York. Horizontal boring, drilling and milling machines or floor boring machines. The twenty-four types illustrated represent a complete line of machines designed for boring, drilling, facing and milling work which is too large to be conveniently handled on other types of machines. The first part of the catalog is devoted to illustrating and describing the machines, which are of two types. While both have a heavy column on which the spindle can be adjusted at any hight, in the first type the column has rapid traverse and slow milling feeds along one side of a floor plate, and in the second type the column is stationary and a traversing table moves the work under the spindle. On the latter pages a number of photographs are reproduced showing the machines in operation on various classes of work and illustrating the advantages of the use of machines of this type for boring, drilling, facing and milling heavy and awkward pieces of work. By using a circular table all these operations may be performed at one setting. The catalog is attractively arranged, printed on coated paper, well illustrated by half-tones, with striking cover effect. 9x12, pp. 47, paper.

Manufacturers.

The Pollock Fertilizer Company, Baltimore, Md., is planning to build a large plant.

The Empire Cream Separator Company is about to enlarge its plant in Bloomfield, N. J.

Boiler plate mills of the Central Iron & Steel Company, Harrisburg, Pa., have been burned.

Pomeroy Bros. & Co., of Hagerstown, Md., manufacturers of spokes, etc., will rebuild a factory.

The Damascus Brake Beam Company, St. Louis, Mo., may establish a factory at Youngstown, O.

The contract for constructing shops for the Lombard Log Hauler Company at Waterville, Me., has been awarded.

A new three-story building is to be erected to be occupied by the New England Whip Company, Springfield, Mass.

The Saginaw (Mich.) Whistle Company has increased its capital stock to $15,000. A factory will probably be constructed.

The Sherwin-Williams Company, paint manufacturer, Cleveland, O., will build an addition to its Montreal (Que.) plant.

A contract has been awarded for an extension of the Toledo (O.) Castings Company's plant, which will double the capacity.

The Balke Manufacturing Company, furniture manufacturer, Grand Rapids, Mich., plans for a five-story factory, 100 feet square.

A veneer factory will be established at Grand Marais, Mich., by James C. Walker, of Alpena, and others, forming a new company.

The Madison County Spinning Company, Huntsville, Ala., is, we understand, getting ready to begin the erection of a $150,000 addition to its mill.

The Stiener Mantel Company, Baltimore, Md., is about to erect a 60x150-foot, three-story factory building, boiler-house and engine-room, kilns, etc.

The Mitchell & Lewis Company, of Racine, Wis., manufacturer of wagons, is said to have purchased a site for the erection of a big storehouse and factory.

Officials of the Corn Products Company from Chicago have been visiting the starch works at Oswego, N. Y., to arrange for the erection of a power plant.

The Prouty-Bowler Soap Company, Des Moines, Ia., will erect a $10,000 addition to its plant. An addition will be built to its boiler-house, 130x22 feet.

The contract has been let to build for the H. V. Hartz Company, at Cleveland, O., a three-story building, about 100x200 feet. Henry V. Hartz is a machinist.

Representatives of the American Radiator Company, Chicago, Ill., have signed contracts with citizens of Litchfield by which the company is to build a radiator factory there.

William Kaiser, of Muscatine, Iowa., lumber and logging, who is interested in mills and owns a box factory at South Stillwater, Minn., has decided to improve the plant.

An effort is being made to organize a company to erect a packing house at the Central Stockyards, Louisville, Ky. Rush Watkins, John Moran and others are said to be interested.

The Blackstone (Mass.) Manufacturing Company is conditionally planning to build at North Smithfield, R. I., a cotton mill having 45,000 or 50,000 spindles and about 11,000 looms.

A rolling mill at the St. Louis, Mo., plant of the Hoyt Metal Company has been burned and will at once be rebuilt. The operation of the plant as a whole is not seriously interfered with.

It is stated at Columbus, O., that the Franklin Brick Company has been incorporated; capital, $100,000. President, E. Doddington; secretary, Frank Hunter. The plant will be located at Taylor's Station.

The Detroit (Mich.) Register Company, manufacturer of registers, ventilators, sad irons and iron novelties, will go to Milan, Mich., where it is building a plant. Some, if not all, of the machinery has been ordered.

The Board of Trade of Waterloo, N. Y., is considering a proposition from J. O. (Otto J.?) Spencer, of Union Springs, who suggests the establishment of a plant for the manufacture of the "Wideawake" threshing machine.

The George A. Hogg Iron & Steel Foundry Company, Pittsburgh, Pa., has decided to erect a larger plant, and a site of 25 acres has been secured at Rosslyn. To erect this plant an increase of $650,000 in the capital stock has been authorized.

Charles R. Brownell, of Berwick, La.; R. N. De Merrell, of Holland, Mich., and M. W. Palmer, of Hamilton, Mich., have formed a partnership for the purpose of manufacturing a beet puller and topper. Work is about to begin on the factory.

It is proposed to start a large factory to build narrow-gage railroad cars at Owen Sound, Ont. William Robinson, late of the Transportation Railway in Costa Rica, is promoting the enterprise and is in touch with the Board of Trade.

The Russell & Erwin Manufacturing Company, of New Britain, Conn., one of the constituent plants of the American Hardware Company, is to build a new engine-house. A Corliss engine of 1,500 horse-power maximum capacity will be installed.

Proctor & Gamble Company, Cincinnati, O., will build a factory at Kansas City to manufacture soap and refine oil. The cost, it is said, will be $1,000,000. Small plants will be erected in various parts of Kansas to gather cotton seed for the refinery.

The Wisconsin Legislature having passed a bill granting a charter to the Cornell Land & Power Company, of Eau Claire, to erect a dam across the Chippewa River at Brunette Falls, capitalists have inspected the location and may erect large paper and pulp mills there.

It is said that among three new buildings to be erected at the Lynn, Mass., works of the General Electric Company is a 650x350-foot turbine factory. We believe that some such report was circulated and contradicted earlier in the year, so publish the present item for what it is worth.

Charles S. Tupper, representing the Goodyear interests, of Buffalo, N. Y., has practically closed for a tract of 3,500 acres of timber land in Upper Pocahontas and Lower Pendleton Counties, W. Va., according to information received in Buffalo. It is the intention to erect tanneries and pulp mills on the West Virginia tract.

The Michigan Steam Pump & Manufacturing Company, of Trenton, Mich., is about to erect a plant there for the manufacture of high-pressure pumps, the result of a recent invention, which embraces some new features. The pumps will be made with capacities ranging from 75,000 to millions of gallons per day. They are double gear rotary Fisher pumps. The rights were brought from Denver, Colo. The first building proposed will be 50x125 feet. For the present the castings will be made out of the village.

Miscellaneous Wants.

Advertisements will be inserted under this head at 25 cents a line, each insertion. Copy should be sent to reach us not later than Saturday morning for the ensuing week's issue. Answers addressed to our care will be forwarded.

Grant. Gears. See upper corner, page 62.

Caliper cat. free. E. G. Smith, Columbia, Pa.

Punches & dies. Wal.M.Wks.,Waltham,Mass.

Patterns.—Cincinnati Pat. Wks., Cincin., O.

Drawings, patterns and models to order. Ashland Tool Co., Ashland, Pa.

Will buy or pay royalty for good patented machine or tool. Box 282, AMER. MACH.

Working drawings or special machinery. Geo. M. Mayer, M. E. Monadnock, Chicago.

Light and fine mach'y to order; models and elec. work specialty. E. O. Chase, Newark, N. J.

Automatic machinery designed and constructed by the Wellman Sole Cutting Machine Co., Medford, Mass.

Special and light machinery, models; subpress and blanking dies a specialty, also fine tool work. Box 250, Waterbury, Conn.

Wanted—Competent managers, superinten-

dents and foremen. James Brady, Room J, 20th Floor, 220 Broadway, New York.

Designing auto. mach'y tools for interchangeable work a specialty; drawings made at moderate prices. Box 943, New Haven, Ct.

Machinists—Send 10 cents for blueprint table of U. S. S. steam, gas and water pipe, giving tapping sizes. E. E. Meyer, Allegheny, Pa.

Wanted—Contract and jobbing work on medium and heavy weight machinery and parts; prompt delivery. U. S. Rapid-Fire Gun & Power Co., Derby, Conn.

Capital wanted by well-established works to handle increasing business; practical partner preferred; fine opportunity; high references required and given. Apply "Engine Builder," care AMERICAN MACHINIST.

Wanted—A first-class man to take a responsible position in a modern machine manufacturing plant, in a desirable city of one of the Middle States; must have had experience in manufacturing sewing machines, gun work or some light, high-grade machine manufacturing; must be familiar with the most advantageous ways and means of manufacturing by the use of modern, up-to-date machinery, fixtures and methods; a man of ability and character, who has had experience and is a good manager of men, who is systematic, broad gage and knows how to get results, can secure a good, permanent position; state age, experience, references and salary wanted. Write full particulars to Box 268, AMER. MACHINIST.

For Sale.

For Sale—Complete set of patterns, drawings, blueprints and some gages for heavy vertical spindle milling machine; will accept reasonable price and give good reason for selling. Address Box 297, AMER. MACHINIST.

For Sale—An established and successful machinery manufacturing business in a town of 10,000 inhabitants; modern brick buildings, fine water power, good shipping facilities, etc.; satisfactory reasons for selling; a grand opportunity to the right party who can invest not less than $100,000 after the fullest investigation. Address "Machinery Manufacturer," care AMERICAN MACHINIST.

Wants.

Situation and Help Advertisements only inserted under this head. Rate 25 cents a line for each insertion. About six words make a line. No advertisements under two lines accepted, and no advertisements abbreviated. The cash and copy should be sent to reach us not later than Saturday morning for the ensuing week's issue. Answers addressed to our care will be forwarded. Applicants may specify names to which their replies are not to be forwarded; but replies will not be returned. If not forwarded they will be destroyed without notice. Original letters of recommendation or other papers of value should not be enclosed to unknown correspondents. State mentioned indicates present address of advertiser.

Situations Wanted.

CONNECTICUT.

Wanted—Position as superintendent, by head draftsman, now with a well-known firm, builders of metal-working machinery. Address Box 317, AMERICAN MACHINIST.

ILLINOIS.

Mechanical engineers want positions; we have investigated their records and can furnish competent men for all kinds of technical work. Engineering Agency, Chicago.

MASSACHUSETTS.

Machine shop foreman wishes position; experienced in modern methods, manufacturing and experimental work; first-class draftsman; best of references furnished; Boston or vicinity preferred. Box 323, AMER. MACHINIST.

NEW JERSEY.

Experienced mechanical draftsman, young man, desires position; good references. Box 312, AMERICAN MACHINIST.

Position wanted by experienced foreman or assistant superintendent on tool, machine or experimental work; inventive abilities; best of references. Box 315, AMER. MACHINIST.

Mechanical and electrical engineer, good business man, has done all purchasing for shop, is now mechanical superintendent, wishes to change on account of climate; good judge of values. Box 316, AMER. MACHINIST.

NEW YORK.

Machine designer, etc., wants position. Address Box 63, AMERICAN MACHINIST.

Draftsman, familiar with machinery, mill and furnace work, wishes position in the vicinity of New York. Box 324, AM. MACH.

Wanted—Position as foreman patternmaker by experienced mechanic, competent to handle both men and work to advantage. Box 325, AMERICAN MACHINIST.

Draftsman, college graduate, with good practical experience, desires position; best of references; salary moderate to start. Address Box 313, AMERICAN MACHINIST.

European graduate in mechanical and electric engineering, 4 years' drawing-room, 4 years' shop experience, desires steady engagement with progressive concern; also fitted to represent here or in foreign countries. Address Box 328, AMERICAN MACHINIST.

Situation as superintendent of factory manufacturing machine and wood screws, bolts and nuts, by man with large practical experience in all branches of above business; technical education; capable of designing and building automatic machinery; can handle men to advantage. Box 291, AMER. MACH.

Wanted—Position as superintendent or general foreman, by a practical, up-to-date man, thoroughly familiar with the latest shop methods and system of cost-keeping; 18 years' experience in charge of help; light interchangeable work preferred; am employed; best of references to those who desire the services of a hustler. Address M. A. C., 1056 Decatur st., Brooklyn N. Y.

OHIO.

Assistant superintendent or general foreman, with exceptional ability and experience, wishes to make a change. Box 295, AM. M.

A small firm manufacturing heavy machinery can secure half the time of a mechanical engineer and designer for $1,500 a year; age 32; technical graduate; 12 years experience designing machinery, handling draftsmen, etc. W. S. G., care AMERICAN MACHINIST.

PENNSYLVANIA.

An experienced machinist on engine work is open to engagement after July 1; not engaged in shop work at present the reason for this advertisement; Pennsylvania or West preferred. Address "Engine Machinist," care AMERICAN MACHINIST.

Help Wanted.

CONNECTICUT.

Wanted—Hot copper sheet roller on miscellaneous sheet, etc., for mill turning out 40,000 to 50,000 lbs. of sheet copper per month and 250,000 breaking down. Address and state wages required and references, Box 296, AMERICAN MACHINIST.

ILLINOIS.

Draftsmen for all classes of work; over 200 actual vacancies for tecnnical men; 5,000 positions filled in 10 years. Engineering Agency, 19 Monadnock Block, Chicago.

College instructors for advance machine design, mechanical drawing, wood-working and patternmaking, forge and foundry work, electricity, etc.; $900 to $1,500. Engineering Agency, Chicago.

We are constantly increasing the scope of our work and invite applications for positions from first-class patternmakers, molders and core-makers; we always have vacancies. Address Allis-Chalmers Co., Lock Box No. 1065, Chicago.

MAINE.

Wanted—Expert die sinker of large experience; highest wages or salary to the right man. Address "Drop Forge," care AM. M.

MASSACHUSETTS.

Machinists wanted; good, all-round men on special automatic machinery; good pay and steady work. Apply to L. F. Fales, Walpole, Mass.

Wanted—Immediately three first-class diesinkers for drop forge work. United Shoe Machinery Co., McKay Dept. Factory, Winchester, Mass.

Wanted—A good mechanic, capable of aiding us in doing experimental and development work on manufacturing sewing machines. "Sewing Machine Co.," care AMER. MACH.

MICHIGAN.

Wanted—Machinists and machine hands; Detroit, Mich. Apply Box 322, AM. MACH.

Wanted—A good machinist to work on tools and jigs of a simple character and keep dies in order; also to take the place of regular lathe and boring machine hands when sick or off on business; would prefer a man who has previously had charge of a small shop, as the position offered is practically a working assistant of our present foreman; in answering, write fully regarding experience, stating age, whether married or single and salary expected; all correspondence strictly confidential. Box 308, AMER. MACHINIST.

NEW JERSEY.

Foreman in lawn mower factory; first-class machinist and jig maker. S. P. Townsend & Co., Orange, N. J.

Wanted—Lathe and planer hands for night work on heavy machine tool work; good wages to good men. Apply to The Pond Machine Tool Company, Plainfield, N. J.

NEW YORK.

Wanted—A thoroughly competent instrument maker; state experience and pay expected. Address C. D., care AMER. MACHINIST.

Wanted—At once, two first-class metal pattern makers and five first-class toolmakers. The Corrington Air Brake Co., Matteawan, N. Y.

Wanted—Several experienced mechanical, electrical and architectural draftsmen. Apply, stating experience and salary expected, Engineer in Charge, Drafting Dept., General Electric Company, Schenectady, N. Y.

Wanted—Immediately, 50 lathe, planer, milling machine and vise hands; steady employment and good wages; we build engine lathes and other machine tools. Apply to or address The W. P. Davis Machine Co., Rochester, N. Y.

Superintendent, with technical education and experience, for manufacturing and foundry departments of large establishment in central New York, manufacturing iron goods, employing 500 to 600 men; state age and experience; only bright and aggressive men need apply. Box 309, AMERICAN MACHINIST.

Machinists wanted in a small manufacturing town, one hour's ride from New York city; wages $2.50 per day of 9 hours; time and a half for over time; factory employs about 300 men; has been in existence over 20 years, during which time it has never reduced wages or laid off men for lack of work; special inducements will be offered desirable men at this time; state nationality, age and experience for past 5 years. Box 200, AM. M.

OHIO.

Patternmakers or men with some experience. Cincinnati Pattern Works, Cincinnati, Ohio.

Help Wanted.—Fifty first-class machine patternmakers; only competent, fast men need apply. Address Dayton Pattern Works, Dayton, O.

Wanted—Lathe hands, planer hands, vise hands, milling machine hands; good wages and steady work. Apply to the Harris Automatic Press Company, Niles, O.

Wanted—Foreman, capable of handling growing shop of 75 men, making general line of automatic machinery, familiar with modern methods; salary $2,000 to start. Box 327, AMERICAN MACHINIST.

Wanted—An all-round machinist to act as superintendent in a shop, in Cincinnati, doing light manufacturing and special work and employing between 20 and 30 men; applicant must be capable of overseeing machine and vise work and must have had experience as foreman of both; a good opening for an energetic and up-to-date young man. Apply, giving, age, whether married and references (which will be treated as strictly confidential), Box 278, AMERICAN MACHINIST.

PENNSYLVANIA.

Wanted—First-class fitters, experienced on vertical boring and turning mills; good wages and steady employment. Coburn Machine Tool Company, Franklin, Pa.

Wanted—Competent foreman over about 20 men in brass department of electrical works, also an experienced man for general inspector; state age, salary and reference. Address Box 326, AMERICAN MACHINIST.

We are constantly increasing the scope of our work and invite application for positions from first-class patternmakers, molders and machinists; we always have vacancies. Address The Westinghouse Machine Company, East Pittsburgh, Pa.

Wanted—Thorough, competent general foreman to take charge of shop for building pipe-threading machinery; must have had experience in all its branches; give age, experience, salary expected and reference. Box 319, AMERICAN MACHINIST.

Wanted—Machinists for floor, vise and machine work in a new machine shop with all modern equipment, building steam engines and general machinery; in applying state your age, experience and reference. Apply or address Kenney & Co., Scottdale, Pa.

Wanted—General office man for foundry and machine business; must be sober, active and a methodizer; prefer one between 30 and 40 years of age; town 40,000 population. Address, stating experience and salary expected, "Central Pennsylvania," care AMER. MACH.

Wanted—A superintendent with experience to take charge of a prosperous and up-to-date machine shop foundry and wrought-iron shop in eastern Pennsylvania, employing about 300

men; a permanent position for a man with push and energy. State experience and address M. S., care AMERICAN MACHINIST.

Wanted—Thorough, competent general foreman to take complete charge of machinery end of a shop manufacturing cast and malleable iron pipe fittings and valves; must have had experience in the best methods, designing machinery for same, etc.; give age, experience, salary expected and also references. Box 318, AMERICAN MACHINIST.

Wanted—Experienced foreman for machinists in a modern and up-to-date machine shop manufacturing steam engines and general machinery; must understand modern methods of conducting a shop and handling men; must state age, experience in full, to have application considered, also state salary expected. Address Box 320, AMERICAN MACHINIST.

Wanted—General works foreman in plant employing about 400 men and doing a general foundry and machine business; an excellent opportunity is offered to a man of experience who is up to date on machine tools and who is capable of handling department foremen with object of pushing work through from pattern shop to shipment. Address Box 314, AMERICAN MACHINIST.

Wanted—Mechanical superintendent to take entire charge shops, foundry and machine works employing 150 hands, manufacturing automatic cut-off engines and doing general mill and factory repairs; must be thorough in all branches, well up in modern shop practice and capable of producing results; state age, experience and references. "Penna," care AMERICAN MACHINISTS.

Wanted—Superintendent for a new plant manufacturing steam engines for hoisting and haulage in coal mines and other general machinery; will employ 200 men; factory and machinery are modern; applicant must have mechanical ability, energy, experience and executive ability; in applying be sure and state your age and full experience and references as to where you have been in charge of machine shop, also state salary expected. Address Box 321, AMERICAN MACHINIST.

WEST OF MISSISSIPPI.

Wanted—Experienced foundry foreman; shop employing 20 molders. Union Iron Works, Spokane, Wash.

WISCONSIN.

Wanted—Competent machine and bench hands. The Kempsmith Mfg. Co., Milwaukee, Wis.

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Northampton Emery Wheel Co., Leeds, Mass.
Norton Emery Wheel Co., Worcester, Mass.

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Barnes Co., W. F. & John, Rockford, Ill
Wilmarth & Morman Co., Grand Rapids, Mich.

Ball Bearings
See Roller Bearings.

Balls, Steel
Federal Mfg. Co., Cleveland, O.

Barrels, Steel
Kilbourne & Jacobs Mfg. Co., Columbus, O.

Bars, Boring
Cleveland Twist Drill Co., Cleveland, O.
Underwood & Co., H. B., Philadelphia, Pa.

Belt Dressing
Dixon Crucible Co., Jos., Jersey City, N. J.
Harris Oil Co., A. W., Provi., R. I.

Belt Filler
Schieren & Co., Chas. A., New York.

Belting, Leather
Patterson, Gottfried & Hunter, Ltd., New York.
Schieren & Co., Chas. A., New York.
Shultz Belting Co., St. Louis, Mo.

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N. Y. Belting & Packing Co., New York.
Peerless Rubber Mfg. Co., New York.

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Barr, H. G., Worcester, Mass.

Bending Machinery, Plate
Hilles & Jones Co., Wilmington, Del.
Perkins Mach. Co., So. Boston, Mass.
Wickes Bros., New York.

Bending Machines, Hydraulic
Bement, Miles & Co., New York.
Watson-Stillman Co., New York.

Bending Machines, Power
Bethlehem Foundry & Mach. Co., So. Bethlehem, Pa.
Cincinnati Punch & Shear Co., Cincinnati, O.
Reade Mchry. Co., Cleveland, O.

Blocks and Tackles
See Hoists, Hand.

Blowers
Am. Gas Furnace Co., N. Y. City.
Buffalo Forge Co., Buffalo, N. Y.
Champion Blower & Forge Co., Lancaster, Pa.
Exeter Mach. Wks., Exeter, N. H.

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Keuffel & Esser Co., New York.
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Baird & Co., Henry Carey, Philadelphia, Pa.
Derry-Collard Co., New York.
Henley & Co., N. W., New York.
Wiley & Sons, John, New York.

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Acme Mchry. Co., Cleveland, O.
Detrick & Harvey Mach. Co., Baltimore, Md.
Howard Iron Wks., Buffalo, N. Y.
Maines Mach. Co., Philadel., Pa.
Pratt & Whitney Co., Hartford, Conn.
Reliance Mach. & Tool Co., Cleveland, O.
Wells Bros. Co., Greenfield, Mass.

Boring and Drilling Machines, Horizontal
Barnes Co., B. F., Rockford, Ill.
Barnes Co., W. F. & John, Rockford, Ill.
Beaman & Smith Co., Provi., R. I.
Bement, Miles & Co., N. Y. City.
Betts Mach. Co., Wilmington, Del.
Binsse Mach. Co., Newark, N. J.
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Detrick & Harvey Mach. Co., Baltimore, Md.
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Pond Mach. Tool Co., New York.
Pratt & Whitney Co., Hartford, Conn.
Prentiss Tool & Supply Co., New York.
Warner & Swasey Co., Cleveland, Ohio.

Boring and Turning Mills
American Tool Wks. Co., Cin., O.
Baush Mach. Tool Co., Springfield, Mass.
Bement, Miles & Co., New York.
Betts Mach. Co., Wilmington, Del.
Brown & Zortman Mchy. Co., Pittsburg, Pa.
Bullard Mach. Tool Co., Bridgeport, Conn.
Hill, Clarke & Co., Boston, Mass.
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Warner & Swasey Co., Cleveland, Ohio.

Carborundum
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Castings, Brass
Kisinger-Ison Co., Cincinnati, O.

Castings, Die Molded
Franklin Mfg. Co., Syracuse, N. Y.

Castings, Steel
Christensen Engineering Co., Milwaukee, Wis.
National Electric Co., Milwaukee, Wis.
Uniform Steel Co., Rahway, N. J.

Centering Machines
Bement, Miles & Co., New York.
Niles Tool Works Co., New York.
Phoenix Mfg. Co., Hartford, Conn.
Pond Mach. Tool Co., New York.
Whiton Machine Co., D. E., New London, Conn.
Woodward & Rogers Co., Hartford, Conn.

Centers, Planer
Fay & Scott, Dexter, Me.
New Haven Mfg. Co., New Haven, Conn.
Pratt & Whitney Co., Hartford, Conn.
Reed Co., F. E., Worcester, Mass.

Chains, Driving
Boston Gear Works, Boston, Mass.
Bridgeport Chain Co., Bridgeport, Conn.
Federal Mfg. Co., Cleveland, O.
Jeffrey Mfg. Co., The, Columbus, Ohio.
Link Belt Engr. Co., Phila., Pa.
Morse Chain Co., Trumansburg, N. Y.
Whitney Mfg. Co., Hartford, Ct.

Chucking Machines
Brown & Sharpe Mfg. Co., Providence, R. I.
Cleveland Automatic Mach. Co., Cleveland, O.

Chucking Machines—*Cont'd*
Draper Mach. Tool Co., Worcester, Mass.
Le Blond Mach. Tool Co., R. K., Cincinnati, O.
Potter & Johnston Mach. Co., Pawtucket, R. I.
Pratt & Whitney Co., Hartford, Conn.
Quint, A. D., Hartford, Conn.
Reed Co., F. E., Worcester, Mass.
Warner & Swasey Co., Cleveland, Ohio.
Windsor Mach. Co., Windsor, Vt.

Chucks, Drill
Almond, T. R., Brooklyn, N. Y.
Brown & Co., R. H., New Haven, Conn.
Cleveland Twist Drill Co., Cleveland, O.
Cushman Chuck Co., Hartford, Ct.
Goodell-Pratt Co., Greenfield, Mass.
The E. Horton & Sons Co., Windsor Locks, Conn.
Modern Tool Co., Erie, Pa.
Morse Twist Drill & Mch. Co., New Bedford, Mass.
Pratt Chuck Co., Frankfort, N. Y.
Standard Tool Co., Cleveland, O.
Trump Bros. Mach. Co., Wilmington, Del.
Whitney Mfg. Co., Hartford, Ct.
Whiton Mach. Co., D. E., New London. Conn.

Chucks, Lathe
Cushman Chuck Co., Hartford, Ct.
Hoggson & Pettis Mfg. Co., New Haven, Conn.
The E. Horton & Son Co., Windsor Locks, Conn.
Pratt & Whitney Co., Hartford, Conn.
Skinner Chuck Co., New Britain, Conn.
Westcott Chuck Co., Oneida, N. Y.
Whiton Mach. Co., D. E., New London, Conn.

Chucks, Scroll
Whiton Mach. Co., D. E., New London, Conn.

Chucks, Split
Faneuil Watch Tool Co., Boston, Mass.

Clocks, Watchman's
Nanz & Co., H., New York.

Clutches, Friction
Caldwell, Son & Co., H. W., Chicago, Ill.
Faneuil Watch Tool Co., Boston, Mass.
Jacobson Mach. Mfg. Co., Warren, Pa.
Kisinger-Ison Co., Cincinnati, O.
New Haven Mfg. Co., New Haven, Conn.
Patterson, Gottfried & Hunter, Ltd., New York.
Pratt & Whitney Co., Hartford, Conn.
Smith, F. L., Franklin Falls, N. H.

Compound, Boiler
Harris Oil Co., A. W., Provi., R. I.

Compound, Pipe Joint
Dixon Crucible Co., Jos., Jersey City, N. J.

Compressors, Air
Blanchard Mach. Co., Boston, Mass.
Chicago Pneumatic Tool Co., Chicago, Ill.
Christensen, N. A., Milwaukee, Wis.
Curtis & Co. Mfg. Co., St. Louis, Mo.
Gray-Blaisdell Co., Bradford, Pa.
Herron & Bury Mfg. Co., Erie, Pa.
Ingersoll-Sergeant Drill Co., New York.
Jacobson Mach. Mfg. Co., Warren, Pa.
Rand Drill Co., New York.

Consulting Engineer
Thompson, Hugh L., Waterbury, Conn.

Controllers and Starters, Electric Motor
Cutler-Hammer Mfg. Co., Milwaukee, Wis.

Coping Machines
Long & Allstatter Co., Hamilton, Ohio.

Correspondence Schools
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Counterbores
Slocomb Co., J. T., Provi., R. I.

Countershafts
Builders' Iron Fdry., Provi., R. I.
National Machine Tool Co., Cincinnati, O.
Pratt & Whitney Co., Hartford, Conn.
Reeves Pulley Co., Columbus, Ind.
Wilmarth & Morman Co., Grand Rapids, Mich.

Counters, Machinery
Veeder Mfg. Co., Hartford, Conn.

Counting and Printing Wheels
Franklin Mfg. Co., Syracuse, N. Y.

Couplings, Shaft
Caldwell & Son Co., H. W., Chicago, Ill.
Cresson Co., Geo. V., Philadel., Pa.
Davis Mach. Co., W. P., Rochester, N. Y.
Patterson, Gottfried & Hunter, Ltd., New York.
Stuart, R. J., New Hamburg, N. Y.

Cranes
Brown Hoisting Mach. Co., N. Y. City.
Case Mfg. Co., Columbus, O.
Chambersburg Engr. Co., Chambersburg, Pa.
Cleveland Crane & Car Co., Cleveland, O.
Curtis & Co. Mfg. Co., St. Louis, Mo.
Franklin Portable Crane & Hoist Co., Franklin, Pa.
Lane Mfg. Co., Montpelier, Vt.
Niles-Bement-Pond Co., New York.
Northern Engineering Works, Detroit, Mich.
Obermayer Co., S., Cincinnati, O.
Pawling & Harnischfeger, Milwaukee, Wis.
Sellers & Co., Wm., Philadel., Pa.
Whiting Foundry Equipment Co., Harvey, Ill.

Crank Pin Turning Machine
Underwood & Co., H. B., Philadelphia, Pa.

Crucibles
Dixon Crucible Co., Jos., Jersey City, N. J.
Obermayer Co., S., Cincinnati, O.

Cupolas, and Ladles, Foundry
Northern Engr. Works, Detroit, Mich.
Obermayer Co., S., Cincinnati, O.
Paxson Co., J. W., Philadel., Pa.
Whiting Foundry Equip. Co., Harvey, Ill.

Cutters, Milling
Becker-Brainard Milling Mach. Co., Hyde Park, Mass.
Brown & Sharpe Mfg. Co., Providence, R. I.
Cleveland Twist Drill Co., Cleveland, O.
Gay & Ward, Athol, Mass.
Ingersoll Milling Mach. Co., Rockford, Ill.
Morse Twist Drill & Mach. Co., New Bedford, Mass.
Rogers, John M., Boat, Gage & Drill Works, Gloucester City, N. J.
Standard Tool Co., Cleveland, O.
Whitney Mfg. Co., Hartford, Conn.

Cutting-off Machines
Bement, Miles & Co., New York.
Bignall-Keeler Mfg. Co., Edwardsville, Ill.
Brown & Sharpe Mfg. Co., Providence, R. I.
Davis Mach. Co., W. P., Rochester, N. Y.
Hurlbut-Rogers Mach. Co., South Sudbury, Mass.
Newton Mach. Tool Wks., Philadelphia, Pa.
Niles Tool Works Co., New York.
Pond Mach. Tool Co., New York.

Cutting-off Tools
Armstrong Bros. Tool Co., Chicago, Ill.
O. K. Tool Holder Co., Shelton, Conn.
Pratt & Whitney Co., Hartford, Conn.

Cyclometers
Veeder Mfg. Co., Hartford, Conn.

Diamond Tools
Steel Set Diamond Co., New York.

Dies, Sheet Metal
Bliss Co., E. W., Brooklyn, N. Y.
Hay-Budden Mfg. Co., Brooklyn, N. Y.
Perkins Mach. Co., So. Boston, Mass.

Dies, Threading, Opening
Errington, F. A., New York.
Geometric Drill Co., New Haven, Conn.
Jones & Lamson Mch. Co., Springfield, Vt.
Maines Mach. Co., Philadel., Pa.
Modern Tool Co., Erie, Pa.
Pratt & Whitney Co., Hartford, Conn.

Dowel Pins
Obermayer Co., S., Cincinnati, O.
Winkley Co., Hartford, Conn.

Drawing Boards and Tables
Keuffel & Esser Co., New York.

Drawing Instruments
Keuffel & Esser Co., New York.

Drilling Machines, Bench
Barnes Co., W F. & John, Rockford, Ill.
Pratt & Whitney Co., Hartford, Conn.

Drilling Machines, Boiler.
Baush Mch. Tool Co., Springfield, Mass.
Bement, Miles & Co., New York.
Bickford Drill & Tool Co., Cincinnati, O.
Dallett & Co., Thos. H., Phila., Pa.
Niles Tool Works Co., New York.
Pond Mach. Tool Co., New York.

Drilling Machines, Multiple Spindle
Baker Bros., Toledo, O.
Barnes Co., B. F., Rockford, Ill.
Barnes Co., W. F. & John, Rockford, Ill.
Barr, H. G., Worcester, Mass.
Baush Mch. Tool Co., Springfield, Mass.
Bement, Miles & Co., New York.
Bickford Drill & Tool Co., Cincinnati, O.
Dallett & Co., Thos. H., Phila., Pa.
Garvin Mach. Co., New York.
Harrington, Son & Co., Edwin, Philadelphia, Pa.
McCabe, J. J., New York.
Marshall & Huschart Mchry. Co., Chicago, Ill.
National Automatic Tool Co., Dayton, O.
Newton Machine Tool Works, Philadelphia, Pa.
Niles Tool Works Co., New York.
Prentiss Tool & Supply Co., New York.
Woodward & Rogers Co., Hartford, Conn.

Drilling Machines, Pneumatic
Chicago Pneumatic Tool Co., Chicago, Ill.
Cleveland Pneu. Tool Co., Cleveland, O.
Phila. Pneumatic Tool Co., Philadelphia, Pa.
Railway Appliances Co., Chicago, Ill.
Rand Drill Co., New York.
Standard Ry. Equip. Co., St. Louis, Mo.

Drilling Machines, Portable
Dallett & Co., Thos. H., Philadelphia, Pa.
Hisey-Wolf Mch. Co., Cincin., O.

Drilling Machines, Radial
American Tool Wks. Co., Cin., O.
Baush Mch. Tool Co., Springfield, Mass.
Bement, Miles & Co., New York.
Bickford Drill & Tool Co., Cincinnati, O.
Cleveland Punch & Shear Works Co., Cleveland, O.
Dreses Mach. Tool Co., Cincin., O.
Fosdick Mach. Tool Co., Cincin., O.
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Hill, Clarke & Co., Boston, Mass.

Drilling Machines, Radial— *Continued*
McCabe, J. J., New York.
Marshall & Huschart Mchry. Co., Chicago, Ill.
Mueller Mach. Tool Co., Cincin., O.
Niles Tool Works Co., New York.
Pond Mach. Tool Co., New York.
Prentiss Tool & Supply Co., New York.
Reade Mchry Co., Cleveland, O.

Drilling Machines, Turret
Niles Tool Works Co., New York.
Quint, A. D., Hartford, Conn.
Vanderbeek Tool Works, Hartford, Conn.

Drilling Machines, Upright
American Tool Wks. Co., Cin., O.
Baker Bros., Toledo, O.
Barnes Co., B. F., Rockford, Ill.
Barnes Co., W. F. & John, Rockford, Ill.
Barr, H. G., Worcester, Mass.
Bement, Miles & Co., New York.
Brown & Zortman Mchry. Co., Pittsburg, Pa.
Cincinnati Mach. Tool Co., Cin., O.
Davis Mach. Co., W. P., Rochester, N. Y.
Dwight Slate Mch. Co., Hartford, Conn.
Fosdick Mach. Tool Co., Cincinnati, O.
Gould & Eberhardt, Newark, N. J.
Harrington & Son Co., Edwin, Philadelphia, Pa.
Hill, Clarke & Co., Boston, Mass.
Hoefer Mfg. Co., Freeport. Ill.
Le Blond Mach. Tool Co., R. K., Cincinnati, O.
McCabe, J. J., New York.
Marshall & Huschart Mchry. Co., Chicago, Ill.
Niles Tool Works Co., New York.
New Haven Mfg. Co., New Haven, Conn.
Pratt & Whitney Co., Hartford, Conn.
Prentiss Tool & Supply Co., New York.
Sibley & Ware, South Bend, Ind.
Washburn Shops, Worcester, Mass.
Whitney Mfg. Co., Hartford, Conn.
Woodward & Rogers Co., Hartford, Conn.

Drills, Center
Pratt & Whitney Co., Hartford, Conn.
Slocomb Co., J. T., Providence, R. I.

Drills, Rail
Bement, Miles & Co., New York.
Niles Tool Works Co., New York.

Drills, Ratchet
Parker Co., Chas., Meriden, Conn.
Pratt & Whitney Co., Hartford, Conn.

Dust Collectors
Allington & Curtis Mfg. Co., Saginaw, Mich.

Dynamos
C & C Electric Co., New York.
Christensen Engineering Co., Milwaukee, Wis.
Commercial Electric Co., Indianapolis, Ind.
Crocker-Wheeler Electric Co., Ampere, N. J.
Eck Dynamo & Motor Co., Belleville, N. J.
General Elec. Co., New York.
Jantz & Leist Elec. Co., Cincin., O.
Mechanical Appliance Co., Milwaukee, Wis.
Milwaukee Elec. Co., Milwaukee, Wis.
National Electric Co., Milwaukee, Wis.
Northern Elec. Mfg. Co., Madison, Wis.
Robbins & Myers Co., Springfield, Ohio.
Sprague Elec. Co., New York.
Storey Motor & Electric Co., Harrison, N. J.
Triumph Elec. Co., Cincinnati, O.
Western Electric Co., Chicago, Ill.
Westinghouse Electric & Mfg. Co., Pittsburgh, Pa.

Electrical Supplies
Commercial Electric Co., Indianapolis, Ind.
General Elec. Co., New York.
Milwaukee Elec. Co., Milwaukee, Wis.
Storey Motor & Electric Co., Harrison, N. J.
Triumph Elec. Co., Cincinnati, O.
Western Electric Co., Chicago, Ill.
Westinghouse Electric & Mfg. Co., Pittsburgh, Pa.

Elevators
Albro-Clem Elevator Co., Philadelphia, Pa.
Curtis & Co. Mfg. Co., St. Louis, Mo.
Howard Iron Wks., Buffalo, N. Y.
Morse, Williams & Co., Phila., Pa.

Emery Wheels
See Grinding Wheels.

Emery Wheel Dressers
Calder, Geo. H., Lancaster, Pa.

Enclosures, Tool-room
Merritt & Co., Philadelphia, Pa.

Engines, Automobile
Olds Motor Works, Lansing, Mich.

Engines, Gas and Gasoline
Bay State Gas Engine Co., Boston, Mass.
Foos Gas Eng. Co., Springfield, O.
Middletown Mach. Co., Middletown, O.
Mietz, August, New York.
New Era Iron Wks., Dayton, O.
Olds Motor Wks., Lansing, Mich.
Regal Gasoline Engine Co., Coldwater, Mich.
Struthers-Wells Co., Warren, Pa.

Engines, Steam
Buffalo Engine Co., Buffalo, N. Y.
Chandler & Taylor Co., Indianapolis, Ind.
Frick Co., Waynesboro, Pa.
Rand Drill Co., New York.
Struthers-Wells Co., Warren, Pa.

Fans, Electric
General Electric Co., New York.
Northern Elec. Mfg. Co., Madison, Wis.
Sprague Elec. Co., New York.
Western Electric Co., Chicago, Ill.
Westinghouse Elec. & Mfg. Co., Pittsburgh, Pa.

Fans, Exhaust
Buffalo Forge Co., Buffalo, N. Y.

Feed Water Heater and Purifier
Hawley Down Draft Furnace Co., Chicago, Ill.

Files and Rasps
Barnett Co., G. & H., Phila., Pa.
Hammacher, Schlemmer & Co., New York.
Nicholson File Co., Provi., R. I.
Patterson, Gottfried & Hunter, Ltd., New York.

Filing Machines
Cochrane-Bly Mach. Co., Rochester, N. Y.

Fillers, Oil Can
The Winkley Co., Hartford, Conn.

Fittings, Steam
Crane Co., Chicago, Ill.
Crosby Steam Gage & Valve Co., Boston, Mass.
Jenkins Bros., New York.
Lunkenheimer Co., Cincinnati, O.
Walworth Mfg. Co., Boston, Mass.

Flexible Shafts
Chicago Flexible Shaft Co., Chicago, Ill.

Forges
Buffalo Forge Co., Buffalo, N. Y.
Miner & Peck Mfg. Co., New Haven, Conn.
Patterson, Gottfried & Hunter, Ltd., New York.

Forgings, Drop
Billings & Spencer Co., Hartford, Conn.
Miner & Peck Mfg. Co., New Haven, Conn.
Wyman & Gordon, Worcester, Mass.

Forgings, Hydraulic
Wyman & Gordon, Worcester, Mass.

Forgings, Steel
Hay-Budden Mfg. Co., Brooklyn, N. Y.
Wyman & Gordon, Worcester, Mass.

Foundry Furnishings
Obermayer Co., S., Cincinnati, O.
Paxson Co., J. W., Philadel., Pa.
Whiting Foundry Equip. Co., Harvey, Ill.

Furnaces, Coal and Oil
Buffalo Forge Co., Buffalo, N. Y.
Hawley Down Draft Furnace Co., Chicago, Ill.
Jacobson Mach. Mfg. Co., Warren, Pa.
Obermayer Co., S., Cincinnati, O.

Furnaces, Gas
Am. Gas Furnace Co., N. Y., City.
Chicago Flexible Shaft Co., Chicago, Ill.

Furniture, Machine Shop
New Britain Ma h. Co., New Britain, Conn.

Gages, Recording
Bristol Co., Waterbury, Conn.

Gages, Standard
Brown & Sharpe Mfg. Co., Providence, R. I.
Rogers, John M., Boat, Gage & Drill Works, Gloucester City, N. J.
Sawyer Tool Mfg. Co., Fitchburg, Mass.
Slocomb Co., J. T., Prov., R. I.
Starrett Co., L. S., Athol, Mass.

Gages, Steam
Crosby Steam Gage & Valve Co., Boston, Mass.

Gear Cutting Machinery
Becker-Brainard Milling Mach. Co., Hyde Park, Mass.
Bickford Drill & Tool Co., Cin., O.
Brown & Sharpe Mfg. Co., Providence, R. I.
Dwight Slate Mch. Co., Hartford, Conn.
Fellows Gear Shaper Co., Springfield, Vt.
Gleason Tool Co., Rochester, N. Y.
Gould & Eberhardt, Newark, N. J.
Harrington & Son Co., Edwin, Philadelphia, Pa.
Newton Mch. Tool Wks., Phil., Pa.
Niles Tool Works Co., New York.
Whiton Machine Co., D. E., New London, Conn.

Gears, Cut
Bilgram, Hugo, Philadelphia, Pa.
Boston Gear Works, Boston, Mass.
Brown & Sharpe Mfg. Co., Providence, R. I.
Fawcus Mach. Co., Pittsburgh, Pa.
Fellows Gear Shaper Co., Springfield, Vt.
Gleason Tool Co., Rochester, N. Y.
Gould & Eberhardt, Newark, N. J.
Grant Gear Works, Boston, Mass.
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Horsburgh & Scott Co., The, Cleveland, O.
New Process Raw Hide Co., Syracuse, N. Y.
Nuttall Co., R. D., Pittsburgh, Pa.
Patterson, Gottfried & Hunter, Ltd., New York.
Philadelphia Gear Works, Philadelphia, Pa.
Sawyer Gear Wks., Cleveland, O.
Simonds Mfg. Co., Pittsburgh, Pa.

Gears, Molded
Caldwell & Son Co., H. W., Chicago, Ill.
Franklin Mfg. Co., Syracuse, N. Y.
Greenwald Co., I. & E., Cincin., O.

Gears, Rawhide
Chicago Raw Hide Co., Chicago, Ill.
Fawcus Mch. Co., Pittsburgh, Pa.
Horsburgh & Scott Co., Cleveland, Ohio.
New Process Raw Hide Co., Syracuse, N. Y.
Nuttall Co., R. D., Pittsburgh, Pa.

Gears, Worm
Albro-Clem Elevator Co., Philadelphia, Pa.
Fawcus Mach. Co., Pittsburgh, Pa.
Morse, Williams & Co., Phila., Pa.
Nuttall Co., R. D., Pittsburgh, Pa.
Simonds Mfg. Co., Pittsburgh, Pa.

Graphite
Dixon Crucible Co., Jos., Jersey City, N. J.
Lubriphite Co., Jersey City, N. J.
Obermayer Co., S., Cincinnati, O.

Grinders, Center
Heald & Son, L. S., Barre, Mass.
Hisey-Wolf Mach. Co., Cincin., O.

Grinders, Cock
Windsor Mach. Co., Windsor, Vt.

Grinders, Cutter
Adams Co., Dubuque, Iowa.
Automatic Mach. Co., Greenfield, Mass.
Becker-Brainard Milling Mach. Co., Hyde Park, Mass.
Brown & Sharpe Mfg. Co., Providence, R. I.
Cincinnati Milling Mach. Co., Cincinnati, O.
Garvin Machine Co., New York.
Norton Emery Wheel Co., Worcester, Mass.
Pratt & Whitney Co., Hartford, Conn.
Rivett-Lock Co., Boston, Mass.
Woodward & Rogers Co., Hartford, Conn.

Grinders, Disc
Besly & Co., Chas. H., Chicago, Ill.
Gorton Mach. Co., Geo., Racine Wis.
Iroquois Mach. Co., New York.
Ransom Mfg. Co., Oshkosh, Wis.

Grinders, Drill
Gorton Mach. Co., Geo., Racine, Wis.
Heald & Son, L. S., Barre, Mass.
Standard Tool Co., Cleveland, O.
Washburn Shops, Worcester, Mass.
Wilmarth & Morman Co., Grand Rapids, Mich.

Grinders, Tool
Barnes Co., B. F., Rockford, Ill.
Barnes Co., W. F. & John, Rockford, Ill.
Barr, H. G., Worcester, Mass.
Brown & Sharpe Mfg. Co., Providence, R. I.
Diamond Mach. Co., Provi., R. I.
Gisholt Mach. Co., Madison, Wis.
Landis Tool Co., Waynesboro, Pa.
Modern Tool Co., Erie, Pa.
Northampton Emery Wheel Co., Leeds, Mass.
Ransom Mfg. Co., Oshkosh, Wis.
Safety Emery Wheel Co., Springfield, O.
Throop Perforating Co., Buffalo, N. Y.
Whitney Mfg. Co., Hartford, Ct.

Grinding Machines
Brown & Sharpe Mfg. Co., Providence, R. I.
Builders' Iron Foundry, Providence, R. I.
Diamond Mach. Co., Prov., R. I.
Falkenau-Sinclair Co., Phila., Pa.
Goodell-Pratt Co., Greenfield, Mass.
Gorton Mach. Co., Geo., Racine, Wis.
Greenfield Mach. Co., Greenfield, Mass.
Hill, Clarke & Co., Boston, Mass.
Hisey-Wolf Mch. Co., Cincin., O.
Iroquois Mach. Co., New York.
Landis Tool Co., Waynesboro, Pa.
Marshall & Huschart Mchry. Co., Chicago, Ill.
Mechanical Appliance Co., Milwaukee, Wis.
Northampton Emery Wheel Co., Leeds, Mass.
Norton Emery Wheel Co., Worcester, Mass.
Norton Grinding Co., Worcester, Mass.
Prentiss Tool & Supply Co., New York.
Ransom Mfg. Co., Oshkosh, Wis.
Safety Emery Wheel Co., Springfield, Ohio.
Throop Perforating Co., Buffalo, N. Y.
Washburn Shops, Worcester, Mass.
Wilmarth & Morman Co., Grand Rapids, Mich.
Woodward & Rogers Co., Hartford, Conn.

Grinding Wheels
Builders' Iron Foundry, Providence, R. I.
Carborundum Co., Niagara Falls, N. Y.
Diamond Mach. Co., Provi., R. I.
Hampden Cor. Wheel Co., Brightwood, Mass.
Northampton Emery Wheel Co., Leeds, Mass.
Norton Emery Wheel Co., Worcester, Mass.
Safety Emery Wheel Co., Springfield, O.
Whitney Mfg. Co., Hartford, Conn.

Gun Barrel Machinery
Bement, Miles & Co., New York.
Diamond Mach. Co., Provi., R. I.
Niles Tool Works Co., New York.
Pond Mach. Tool Co., New York.
Reed Co., F. E., Worcester, Mass.

Hack Saw Blades and Frames
Diamond Saw & Stamping Wks., Buffalo, N. Y.
Goodell-Pratt Co., Greenfield, Mass.
Hammacher, Schlemmer & Co., New York.
Patterson, Gottfried & Hunter, Ltd., New York.
Starrett Co., L. S., Athol, Mass.
West Haven Mfg. Co., New Haven, Conn.

Hack Saws, Power
Diamond Saw & Stamping Wks., Buffalo, N. Y.
Hoefer Mfg. Co., Freeport, Ill.
West Haven Mfg. Co., New Haven, Conn.

Hammers, Drop
Bement, Miles & Co., New York.
Billings & Spencer Co., Hartford, Conn.
Bliss Co., E. W., Brooklyn, N. Y.
Merrill Bros. Brooklyn, N. Y.
Miner & Peck Mfg. Co., New Haven, Conn.
Perkins Mach. Co., Boston, Mass.

Hammers, Pneumatic
Chicago Pneumatic Tool Co., Chicago, Ill.
Cleveland Pneumatic Tool Co., Cleveland, O.
Dallett & Co., Thos. H., Phila., Pa.
Ingersoll-Sergeant Drill Co., New York.
Phila. Pneu. Tool Co., Philadelphia, Pa.
Railway Appliances Co., Chicago, Ill.
Rand Drill Co., New York.
Standard Ry. Equip. Co., St. Louis, Mo.
Steel Roll Mangle Co., Chicago, Ill.

Hammers, Power
Scranton & Co., The, New Haven, Conn.

Hammers, Steam
Bement, Miles & Co., New York.
Bethlehem Fdry. & Mach. Co., So. Bethlehem, Pa.
Chambersburg Engr. Co., Chambersburg, Pa.
Cleveland Punch & Shear Wks. Co., Cleveland, O.

Heating and Ventilating Apparatus
Buffalo Forge Co., Buffalo, N. Y.

Heating Machines, Automatic
Am. Gas Furnace Co., New York.

Hoisting and Conveying Machinery
Brown Hoisting Mchry. Co., New York.
Caldwell & Son Co., H. W., Chicago, Ill.
Hunt Co., C. W., West New Brighton, N. Y.
Link Belt Engineering Co., Philadelphia, Pa.
Niles-Bement-Pond Co., New York.

Hoists, Electric
C & C Electric Co., New York.
Hunt Co., C. W., West New Brighton, N. Y.
Northern Engineering Works, Detroit, Mich.
Pawling & Harnischfeger, Milwaukee, Wis.
Sprague Electric Co., New York.

Hoists, Hand
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Yale & Towne Mfg. Co., New York.

Hoists, Pneumatic
Chicago Pneumatic Tool Co., Chicago, Ill.
Cleveland Pneumatic Tool Co., Cleveland, O.
Curtis & Co. Mfg. Co., St. Louis, Mo.
Northern Engineering Wks., Detroit, Mich.
Rand Drill Co., New York.

Igniters, Gas Engine
Dayton Electrical Mfg. Co., Dayton, O.

Indicators, Speed
Starrett Co., L. S., Athol, Mass.

Indicators, Steam
Crosby Steam Gage & Valve Co., Boston, Mass.

Injectors
Lunkenheimer Co., Cincinnati, O.
Sellers & Co., Wm., Phila., Pa.

Inspection and Tests
Hunt Co., Robt. W., Chicago, Ill.

Instruction Schools
See Schools, Correspondence.

Insurance, Boiler
Hartford Steam Boiler Insp. & Ins. Co., Hartford, Conn.

Jacks, Hydraulic
Bethlehem Fdry. & Mch. Co., So. Bethlehem, Pa.
Watson-Stillman Co., New York.

Jack Planer
Armstrong Bros. Tool Co., Chicago, Ill.

Key Seaters
Baker Bros., Toledo, O.
Bement, Miles & Co., New York.
Chattanooga Mchry. Co., Chattanooga, Tenn.
Davis Mach. Co., W. P., Rochester, N. Y.
Mitts & Merrill, Saginaw, Mich.
Whitney Mfg. Co., Hartford, Conn.

Keys, Machine
Standard Gauge Steel Co., Beaver Falls, Pa.
Whitney Mfg. Co., Hartford, Ct.

Lamps, Arc
General Electric Co., N. Y. City.
Western Electric Co., Chicago, Ill.
Westinghouse Elec. & Mfg. Co., Pittsburgh, Pa.

Lathe Attachments
National Machine Tool Co., Cincinnati, O.

Lathe Dogs
Armstrong Bros. Tool Co., Chicago, Ill.
Besly & Co., Chas. H., Chicago, Ill.
Le Count, Wm. G., So. Norwalk, Conn.
Pratt & Whitney Co., Hartford, Conn.
Tindel-Morris Co., Eddystone, Pa.

Lathes
American Tool Wks. Co., Cin., O.
Automatic Mach. Co., Greenfield, Mass.
Barnes Co., B. F., Rockford, Ill.
Barnes Co., W. F. & John, Rockford, Ill.
Bement, Miles & Co., New York.
Bradford Mach. Tool Co., Cin., O.
Brown & Zortman Mchry. Co., Pittsburg, Pa.
Bullard Mach. Tool Co., Bridgeport, Conn.
Davis Mach. Co., W. P., Rochester, N. Y.
Diamond Machine Co., Prov., R. I.
Draper Mach. Tool Co., Worcester, Mass.
Fairbanks Co., New York.
Fay & Scott, Dexter, Me.
Flather & Co., Nashua, N. H.
Garvin Mach. Co., New York.
Greaves, Klusman Co., Cincin., O.
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Hendey Mach. Co., Torrington, Ct.
Hill, Clarke & Co., Boston, Mass.
Le Blond Mach. Tool Co., R. K., Cincinnati, O.
Lodge & Shipley Mch. Tool Co., Cincinnati, O.
McCabe, J. J., New York.
Marshall & Huschart Mchry. Co., Chicago, Ill.
Milwaukee Machine Tool Co., Milwaukee, Wis.
New Haven Mfg. Co., New Haven, Conn.
Niles Tool Works Co., New York.
Pond Mach. Tool Co., New York.
Pratt & Whitney Co., Hartford, Conn.
Prentiss Tool & Supply Co., New York.
Reed Co., F. E., Worcester, Mass.
Schumacher & Boye, Cincinnati, Ohio.
Sebastian Lathe Co., Cincin., O.
Seneca Falls Mfg. Co., Seneca Falls, N. Y.
Washburn Shops, Worcester, Mass.

Lathes, Automatic Screw-Threading
Automatic Machine Co., Bridgeport, Conn.

Lathes, Bench
Faneuil Watch Tool Co., Boston, Mass.
Loop-Lock Mach. Co., Waltham, Mass.
Waltham Watch Tool Co., Springfield, Mass.

Lathes, Boring
Streit Mach. Co., A., Cincin., O.

Letters, Pattern
Brim, A. W., Seneca Falls, N. Y.
Butler, A. G., N. Y. City.

Levels
Davis & Cook, Watertown, N. Y.
Mass. Tool Co., Greenfield, Mass.
Starrett Co., L. S., Athol, Mass.

Lockers, Clothes
Merritt & Co., Philadelphia, Pa.
Narragansett Mach. Co., Providence, R. I.

Locomotives, Shop
Hunt Co., C. W., West New Brighton, N. Y.

Lubricants
Besly & Co., Chas. H., Chicago, Ill.
Dixon Crucible Co., Jos., Jersey City, N. J.
Lubriphite Co., Jersey City, N. J.

Lubricators
Besly & Co., Chas. H., Chicago, Ill.
Bowen Mfg. Co., Auburn, N. Y.
Crane Co., Chicago, Ill.
Lubriphite Co., Jersey City, N. J.
Lunkenheimer Co., Cincinnati, O.

Machine Screws
Atlantic Mach. Screw Co., Boston, Mass.
Worcester Mach. Screw Co., Worcester, Mass.

Machinery Builders, Special
American Fdry. & Mach. Co., Hanover, Pa.
Blanchard Mach. Co., The, Boston, Mass.
Eclipse Mach. Co., Cleveland, O.
Fawcus Mch. Co., Pittsburgh, Pa.
Hart, Fredk., Poughkeepsie, N. Y.
Hoefer Mfg. Co., Freeport, Ill.
Pratt & Whitney Co., Hartford, Conn.
Simonds Mfg. Co., Pittsburgh, Pa.
Woodward & Rogers Co., Hartford, Conn.

Machinists' Small Tools
Besly & Co., Chas. H., Chicago, Ill.
Billings & Spencer Co., Hartford, Conn.
Brown & Sharpe Mfg. Co., Providence, R. I.
Cleveland Twist Drill Co., Cleveland, O.
Davis & Cook, Watertown, N. Y.
Hammacher, Schlemmer & Co., New York.
McCrosky, F. B., Cincinnati, O.
Mass. Tool Co., Greenfield, Mass.
Patterson, Gottfried & Hunter, Ltd., New York.
Sawyer Tool Mfg. Co., Fitchburg, Mass.
Slocomb Co., J. T., Provi., R. I.
Standard Tool Co., Cleveland, O.
Starrett Co., L. S., Athol, Mass.
Wyke & Co., J., E. Boston, Mass.

Machinists' Supplies
Hammacher, Schlemmer & Co., New York.
Patterson, Gottfried & Hunter, Ltd., New York.

Mandrels, Expanding
Nicholson & Son, W. H., Wilkesbarre, Pa.

Mandrels, Solid
Cleveland Twist Drill Co., Cleveland, O.
Morse Twist Drill & Mach. Co., New Bedford, Mass.
Rogers, John M., Boat, Gage & Drill Works, Gloucester City, N. J.
Standard Tool Co., Cleveland, O.

Measuring Machines
Rogers, John M., Boat, Gage & Drill Works, Gloucester City, N. J.

Metal, Bearing
Besly & Co., Chas. H., Chicago, Ill.
Patterson, Gottfried & Hunter, Ltd., New York.

Metal, Perforated
Throop Perforating Co., Buffalo, N. Y.

Micrometer Calipers
Brown & Sharpe Mfg. Co., Providence, R. I.
Sawyer Tool Mfg. Co., Fitchburg, Mass.
Slocomb Co., J. T., Providence, R. I.
Starrett Co., L. S., Athol, Mass.

Milling Attachments
The Adams Co., Dubuque, Iowa.
Becker-Brainard Milling Mach. Co., Hyde Park, Mass.
Brown & Sharpe Mfg. Co., Providence, R. I.
Cincinnati Milling Mach. Co., Cincinnati, O.
Whitney Mfg. Co., Hartford, Conn.

Milling Machines, Bench
Faneuil Watch Tool Co., Boston, Mass.
Hill, Clarke & Co., Boston, Mass.
Loop-Lock Mach. Co., Waltham, Mass.
Waltham Watch Tool Co., Springfield, Mass.

Milling Machines, Horizontal
Adams Co., Dubuque, Iowa.
Beaman & Smith Co., Prov., R. I.
Becker-Brainard Milling Mach. Co., Hyde Park, Mass.
Bement, Miles & Co., New York.
Hendey Mach. Co., Torrington, Ct.
Ingersoll Mill. Mach. Co., Rockford, Ill.
Newton Mach. Tool Wks., Philadelphia, Pa.
Niles Tool Works Co., New York.
Pratt & Whitney Co., Hartford, Conn.

Milling Machines, Plain
American Tool Wks. Co., Cin., O.
Becker-Brainard Milling Mach. Co., Hyde Park, Mass.
Bement, Miles & Co., New York.
Brown & Sharpe Mfg. Co., Providence, R. I.
Cincinnati Milling Mach. Co., Cincinnati, O.
Garvin Mach. Co., New York.
Hendey Mach. Co., Torrington, Ct.
Hill, Clarke & Co., Boston, Mass.
Kempsmith Mfg. Co., Milwaukee, Wis.
Le Blond Mach. Tool Co., R. K., Cincinnati, O.
Marshall & Huschart Mchry. Co., Chicago, Ill.
McCabe, J. J., New York.
Owen Mach. Tool Co., Springfield, Ohio.
Prentiss Tool & Supply Co., New York.
Whitney Mfg. Co., Hartford, Ct.

Milling Machines, Portable
Underwood & Co., H. B., Philadelphia, Pa.

Milling Machines, Universal
American Tool Wks. Co., Cin., O.
Becker-Brainard Milling Mach. Co., Hyde Park, Mass.
Bement, Miles & Co., New York.
Brown & Sharpe Mfg. Co., Providence, R. I.
Cincinnati Milling Mach. Co., Cincinnati, O.
Garvin Mach. Co., New York.
Hendey Mach. Co., Torrington, Ct.
Hill, Clarke & Co., Boston, Mass.
Kempsmith Mfg. Co., Milwaukee, Wis.
Le Blond Mach. Tool Co., R. K., Cincinnati, O.
Marshall & Huschart Mchry. Co., Chicago, Ill.
McCabe, J. J., New York.
Niles Tool Works Co., New York.
Owen Mach. Tool Co., Springfield, Ohio.
Prentiss Tool & Supply Co., New York.
Waltham Watch Tool Co., Springfield, Mass.

Milling Machines, Vertical
Becker-Brainard Milling Mach. Co., Hyde Park, Mass.
Bement, Miles & Co., New York.
Brown & Sharpe Mfg. Co., Providence, R. I.
Garvin Mach. Co., New York.
Ingersoll Mill. Mach. Co., Rockford, Ill.
Newton Mch. Tool Works, Philadelphia, Pa.
Niles Tool Works Co., New York.
Owen Mach. Tool Co., Springfield, Ohio.
Pratt & Whitney Co., Hartford, Conn.
Quint, A. D., Hartford, Conn.

Milling Tools, Adjustable
Geometric Drill Co., New Haven, Conn.
Rogers, Boat, Gage & Drill Wks., John M., Gloucester City, N. J.

Molding Machines
Adams Co., The, Dubuque, Iowa.
American Foundry & Mach. Co., Hanover, Pa.
Tabor Mfg. Co., Philadelphia, Pa.

Molds, Hammer and Vise Jaw
Field, Chas. H., Providence, R. I.

Mortising Machines, Chain
New Britain Mch. Co., New Britain, Conn.

Motors, Electric
C & C Electric Co., New York.
Christensen Engr. Co., Milwaukee, Wis.
Commercial Electric Co., Indianapolis, Ind.
Crocker-Wheeler Co., Ampere, N.J.
Eck Dynamo & Motor Wks., Belleville, N. J.
General Electric Co., New York.
Jantz & Leist Elec. Co., Cin., O.
Mechanical Appliance Co., Milwaukee, Wis.
Milwaukee Elec. Co., Milwaukee, Wis.
National Electric Co., Milwaukee, Wis.
Northern Elec. Mfg. Co., Madison, Wis.
Robbins & Myers Co., Springfield, Ohio.
Sprague Electric Co., New York.
Storey Motor & Electric Co., Harrison, N. J.
Triumph Elec. Co., Cincinnati, O.
Western Electric Co., Chicago, Ill.
Westinghouse Elec. & Mfg. Co., Pittsburgh, Pa.

Name Plates
Franklin Mfg. Co., Syracuse, N. Y.
Turner Brass Works, Chicago, Ill.

Nut Tappers
See Bolt and Nut Machinery.

Oil Cups and Covers
Bay State Stamping Works, Worcester, Mass.
Besly & Co., Chas. H., Chicago, Ill.
Bowen Mfg. Co., Auburn, N. Y.
Crane Co., Chicago, Ill.
Lunkenheimer Co., Cincinnati, O.
Tucker, W. W. & C. F., Hartford, Conn.
The Winkley Co., Hartford, Conn.

Oils
Besly & Co., Chas. H., Chicago, Ill.
Harris Oil Co., A. W., Provi., R. I.

Oils, Slushing
Harris Oil Co., A. W., Provi., R. I.

Oil Stones
Pike Mfg. Co., Pike Station, N. H.

Packing, Steam Joint
Jenkins Bros., New York.
N. Y. Belting & Packing Co., New York.
Peerless Rubber Mfg. Co., New York.

Pans, Lathe
New Britain Mch. Co., New Britain, Conn.

Pans, Shop
Kilbourne & Jacobs Mfg. Co., Columbus, O.

Patents
Baldwin, Davidson & Wight, Washington, D. C.
Stevens & Co., Milo B., Washington, D. C.

Pattern Shop Machinery
American Mchry. Co., Grand Rapids, Mich.
Baker Bros., Toledo, O.
Brown & Zortman Mchry. Co., Pittsburg, Pa.
Fay & Scott, Dexter, Me.
Field, Chas. H., Providence, R. I.
Greaves, Klusman & Co., Cin., O.
Prentiss Tool & Supply Co., New York.
Washburn Shops, Worcester, Mass.

Patterns, Wood
Hartford Pattern & Model Co., Hartford, Conn.

Pencils
Keuffel & Esser Co., New York.

Pinion Cutters
Loop-Lock Mach. Co., Waltham, Mass.

Pipe and Fittings
Crane Co., Chicago, Ill.

Pipe Cutting and Threading Machines
Bignall & Keeler Mfg. Co., Edwardsville, Ill.
Curtis & Curtis Co., Bridgeport, Conn.
Merrell Mfg. Co., Toledo, O.
Oster Mfg. Co., Cleveland, O.
Reed Mfg. Co., Erie, Pa.
Saunders' Sons, D., Yonkers, N. Y.
Wells Bros. Co., Greenfield, Mass.

Pipe Fitters' Tools
Cleveland Twist Drill Co., Cleveland, O.
Saunders' Sons, D., Yonkers, N. Y.
Standard Tool Co., Cleveland, O.

Planers
American Tool Wks. Co., Cin., O.
Belmer Mach. Tool Co., Cin., O.
Bement, Miles & Co., New York.
Betts Mach. Co., Wilmington, Del.
Cincinnati Planer Co., Cincin., O.
Detrick & Harvey Mch. Co., Baltimore, Md.
Flather Planer Co., Mark, Nashua, N. H.
Garvin Mach. Co., New York.
Gray Co., G. A., Cincinnati, O.
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Hendey Mach. Co., Torrington, Ct.
Hill, Clarke & Co., Boston, Mass.
McCabe, J. J., New York.
Niles Tool Works Co., New York.
New Haven Mfg. Co., New Haven, Conn.
Pond Mach. Tool Co., New York.
Prentiss Tool & Supply Co., New York.
Sellers & Co., Wm., Phila., Pa.
Whitcomb Mfg. Co., Worcester, Mass.
Woodward & Powell Planer Co., Worcester, Mass.

Planers, Portable
Underwood & Co., H. B., Philadelphia, Pa.

Planers, Rotary
Bement, Miles & Co., New York.
Cleveland Punch & Shear Works, Cleveland, O.
Newton Mach. Tool Wks., Philadelphia, Pa.
Pond Mach. Tool Co., New York.
Underwood & Co., H. B., Philadelphia, Pa.

Presses, Hand
Perkins Mach. Co., So. Boston, Mass.

Presses, Hydraulic
Watson-Stillman Co., New York.

Presses, Power
Automatic Mach. Co., Bridgeport, Conn.
Bethlehem Fdry. & Mch. Co., So. Bethlehem, Pa.
Bliss Co., E. W., Brooklyn, N. Y.
Chambersburg Engr. Co., Chambersburg, Pa.
Perkins Mach. Co., So. Boston, Mass.
Prentiss Tool & Supply Co., New York.

Profilers
Garvin Mach. Co., New York.
Pratt & Whitney Co., Hartford, Conn.

Pulleys
American Pulley Co., Phila., Pa.
Caldwell & Son Co., H. W., Chicago, Ill.
Cresson Co., Geo. V., Phila., Pa.
Federal Mfg. Co., Cleveland, O.
Howard Iron Wks., Buffalo, N. Y.
Patterson, Gottfried & Hunter, Ltd., New York.
Reeves Pulley Co., Columbus, Ind.
The Xylotite Co., Cincinnati, O.

Pulleys, Friction Cone
Evans Friction Cone Co., Boston, Mass.

Pulley Turning and Boring Machines
Harrington, Son & Co., Edwin, Philadelphia, Pa.
New Haven Mfg. Co., New Haven, Conn.
Niles Tool Works Co., New York.
Streit Mach. Co., A., Cincin., O.

Pulleys, Speed Changing
Speed Changing Pulley Co., Indianapolis, Ind.

Pumps, Hydraulic
Watson-Stillman Co., New York.

Punches, Hydraulic
Bement, Miles & Co., New York.
Bethlehem Fdry. & Mch. Co., So. Bethlehem, Pa.
Watson-Stillman Co., New York.

Punches, Power
Bliss Co., E. W., Brooklyn, N. Y.
Bremer Mach. & Tool Co., Kalamazoo, Mich.
Buffalo Forge Co., Buffalo, N. Y.
Cincinnati Punch & Shear Co., Cincinnati, O.
Cleveland Punch & Shear Wks. Co., Cleveland, O.
Hilles & Jones Co., Wilmington, Del.
Long & Allstatter Co., Hamilton, Ohio.
Perkins Mach. Co., S. Boston, Mass.
Reade Mchry. Co., Cleveland, O.

Rack Cutting Machines
Fellows Gear Shaper Co., Springfield, Vt.
Le Blond Mach. Tool Co., R. K., Cincinnati, O.
Reed Co., F. E., Worcester, Mass.

Racks, Cut
Fellows Gear Shaper Co., Springfield, Vt.
Nuttall Co., R. D., Pittsburgh, Pa.
Simonds Mfg. Co., Pittsburgh, Pa.
Standard Gauge Steel Co., Beaver Falls, Pa.

Racks, Tool
New Britain Mach. Co., New Britain, Conn.

Reamers
Cleveland Twist Drill Co., Cleveland, O.
Clough, R. M., Tolland, Conn.
McCrosky, F. B., Cincinnati, O.
Morse Twist Drill & Mach. Co., New Bedford, Mass.
New Process Twist Drill Co., Taunton, Mass.
Pratt & Whitney Co., Hartford, Conn.
Rogers, John M., Boat, Gage & Drill Works, Gloucester City, N. J.
Standard Tool Co., Cleveland, O.
Wells Bros. Co., Greenfield, Mass.

Reaming Stands
Flather Planer Co., Mark, Nashua, N. H.

Rheostats
Cutler-Hammer Mfg. Co., Milwaukee, Wis.

Riveters, Pneumatic
Bement, Miles & Co., New York.
Cleveland Pneumatic Tool Co., Cleveland, O.
Philadelphia Pneumatic Tool Co., Philadelphia, Pa.
Railway Appliances Co., Chicago, Ill.
Rand Drill Co., New York.
Standard Ry. Equip. Co., St. Louis, Mo.

Riveters, Hydraulic
Bement, Miles & Co., New York.
Watson-Stillman Co., New York.

Riveting Machines
Bement, Miles & Co., New York.
Bethlehem Foundry & Mach. Co., So. Bethlehem, Pa.
Chambersburg Engr. Co., Chambersburg, Pa.
Long & Allstatter Co., Hamilton, Ohio.
Perkins Mach. Co., So. Boston, Mass.

Roller and Ball Bearings
Ball Bearing Co., Philadel., Pa.
Bantam Mfg. Co., Bantam, Conn.

Rolling Mill Machinery
Cleveland Punch & Shear Wks. Co., Cleveland, O.
Hilles & Jones Co., Wilmington, Del.
Pratt & Whitney Co., Hartford, Conn.

Rubber Goods, Mechanical
N. Y. Belting & Packing Co., New York.
Peerless Rubber Mfg. Co., New York.

Rules, Steel
Mass. Tool Co., Greenfield, Mass.
Sawyer Tool Co., Fitchburg, Mass.
Slocomb Co., J. T., Provi., R. I.

Safety Valves, Pop
Crane Co., Chicago, Ill.
Crosby Steam Gage & Valve Co., Boston, Mass.
Lunkenheimer Co., Cincinnati, O.

Sand Blast Apparatus
Paxson Co., J. W., Philadel., Pa.

Sand Mixing Machines
Hanna, E. E., Chicago, Ill.
Obermayer Co., S., Cincinnati, O.

Sawing Machines, Metal
Cleveland Punch & Shear Works Co., Cleveland, O.
Cochrane-Bly Mach. Works, Rochester, N. Y.
Newton Mach. Tool Works, Philadelphia, Pa.
Pratt & Whitney Co., Hartford, Conn.
Reade Mchry. Co., Cleveland, O.
West Haven Mfg. Co., New Haven, Conn.

Sawing Machines, Wood
Brown & Zortman Mchry. Co., Pittsburg, Pa.

Schools, Correspondence
Amer. School of Correspondence, Chicago, Ill.
Consolidated Schools, N. Y. City.
International Correspond. Schools, Scranton, Pa.

Schools, Technical
Mich. College of Mines, Houghton, Mich.
State College of Ky., Lexington, Ky.

Screw Machines, Automatic
Brown & Sharpe Mfg. Co., Providence, R. I.
Cleveland Automatic Mach. Co., Cleveland, O.
Dreses Mach. Tool Co., Cincin., O.
Marshall & Huschart Mchry. Co., Chicago, Ill.
Windsor Mach. Co., Windsor, Vt.

Screw Machines, Hand
Brown & Sharpe Mfg. Co., Providence, R. I.
Cleveland Automatic Mach. Co., Cleveland, O.
Draper Mach. Tool Co., Worcester, Mass.
Garvin Mach. Co., New York.
Jones & Lamson Mch. Co., Springfield, Vt.
Pearson Mach. Co., Chicago, Ill.
Potter & Johnston Mach. Co., Pawtucket, R. I.
Pratt & Whitney Co., Hartford, Conn.
Warner & Swasey Co., Cleveland, Ohio.
Windsor Mach. Co., Windsor, Vt.

Screw Machinery, Wood and Lag
Baker Bros., Toledo, Ohio.
Cook Co., Asa S., Hartford, Conn.

Screw Plates
Besly & Co., Chas. H., Chicago, Ill.
Carpenter Tap & Die Co., J. M., Pawtucket, R. I.
Card Mfg. Co., S. W., Mansfield, Mass.
Morse Twist Drill & Mach. Co., New Bedford, Mass.
Oster Mfg. Co., Cleveland, O.
Wells Bros. Co., Greenfield, Mass.

Second Hand Machinery
Baird Machy. Co., Pittsburg, Pa.
Bennett, Geo. L., New York.
Bowler & Co., Geo. H., Cleveland, Ohio.
Brown & Zortman Mchry. Co., Pittsburgh, Pa.
Carlin Mchry. & Supply Co., Allegheny, Pa.
Fairbanks Co., Philadelphia, Pa.
Garvin Mch. Co., New York.
Hill, Clarke & Co., Boston, Mass.
Kinsey Co., E. A., Cincinnati, O.
Marshall & Huschart Mchry. Co., Chicago, Ill.
McCabe, J. J., New York.
Niles-Bement-Pond Co New York.
Packard Machinery Co., O. L., Chicago, Ill.
Pratt & Whitney Co., Hartford, Conn.
Prentiss Tool & Supply Co., New York.
Toomey, Frank, Philadelphia, Pa.
Wickes Bros., New York.
Wormer Machy. Co., C. C., Detroit, Mich.

Shapers
American Tool Wks. Co., Cin., O.
Bement, Miles & Co., New York.
Cincinnati Shaper Co., Cincin., O.
Flather Planer Co., Mark, Nashua, N. H.
Garvin Mach. Co., New York.
Gould & Eberhardt, Newark, N. J.
Hendey Mch. Co., Torrington, Ct.
Hill, Clarke & Co., Boston, Mass.
Kelly Co., R. A., Xenia, Ohio.
Marshall & Huschart Mchry. Co., Chicago, Ill.
New Haven Mfg. Co., New Haven, Conn.
Niles Tool Works Co., New York.
Perkins Mach. Co., So. Boston, Mass.
Potter & Johnston Mach. Co., Pawtucket, R. I.
Prentiss Tool & Supply Co., New York.
Steptoe Shaper Co., John, Cincinnati, O.

Shears, Power
Bethlehem Fdry. & Mch. Co., So. Bethlehem, Pa.
Bliss Co., E. W., Brooklyn, N. Y.
Bremer Mach. & Tool Co., Kalamazoo, Mich.
Buffalo Forge Co., Buffalo, N. Y.
Cincinnati Punch & Shear Co., Cincinnati, O.
Cleveland Punch & Shear Works, Cleveland, O.
Hilles & Jones Co., Wilmington, Del.
Long & Allstatter Co., Hamilton, Ohio.
Perkins Mach. Co., So. Boston, Mass.
Reade Mchry. Co., Cleveland, O.

Shears, Rotary
Bethlehem Foundry & Mach. Co., So. Bethlehem, Pa.
Detrick & Harvey Mach. Co., Baltimore, Md.
Perkins Mach. Co., So. Boston, Mass.

Shelving, Shop
New Britain Mach. Co., New Britain, Conn.

Slide Rests
Reed Co., F. E., Worcester, Mass.

Slotters
Baker Bros., Toledo, Ohio.
Barr, H. G., Worcester, Mass.
Bement, Miles & Co., New York.
Betts Mach. Co., Wilmington, Del.
Garvin Mach. Co., New York.
New Haven Mfg. Co., New Haven, Conn.
Newton Mach. Tool Wks., Philadelphia, Pa.
Niles Tool Works Co., New York.

Sockets and Sleeves
New Process Twist Drill Co., Taunton, Mass.

Sprocket Chains
See Driving Chains.

Stampings, Sheet Steel
Federal Mfg. Co., Cleveland, O.

Stamps, Steel
Schwerdtle Stamp Co., Bridgeport, Conn.

Steel, Machinery
Boker & Co., Hermann, New York.
Patriarche & Bell, New York.
Ward & Son, Edgar T., Boston, Mass.

Steel, Sheet
Federal Mfg. Co., Cleveland, O.
Ward & Son, Edgar T., Boston, Mass.

Steel, Tool
Boker & Co., Hermann, New York.
Firth-Sterling Steel Co., Demmler, Pa.
Patriarche & Bell, New York.
Patterson, Gottfried & Hunter, Ltd., New York.

Stones, Oil
Pike Mfg. Co., Pike Station, N. H.

Straightener, Hydraulic
Bement, Miles & Co., New York.
Watson-Stillman Co., New York.

Swaging Machines
Excelsior Needle Co., Torrington, Conn.

Switchboards
C & C Electric Co., New York.
Triumph Elec. Co., Cincinnati, O.
Western Electric Co., Chicago, Ill.
Westinghouse Elec. & Mfg. Co., Pittsburg, Pa.

Tapping Machines and Attachments
Baker Bros., Toledo, O.
The Beaman & Smith Co., Providence, R. I.
Bickford Drill & Tool Co., Cin., O.
Cincinnati Mach. Tool Co., Cincinnati, O.
Errington, F. A., N. Y. City.
Fosdick Mach. Tool Co., Cin., O.
Garvin Mach. Co., New York.
Geometric Drill Co., New Haven, Conn.
Modern Tool Co., Erie, Pa.
Pratt & Whitney Co., Hartford, Conn.
Quint, A. D., Hartford, Conn.
Whitney Mfg. Co., Hartford, Conn.
Woodward & Rogers Co., Hartford, Conn.

Taps, Collapsing
Geometric Drill Co., New Haven, Conn.

Taps and Dies
Besly & Co., Chas. H., Chicago, Ill.
Card Mfg. Co., S. W., Mansfield, Mass.
Carpenter Tap & Die Co., J. M., Pawtucket, R. I.
Cleveland Twist Drill Co., Cleveland, O.
Crane Co., Chicago, Ill.
Geometric Drill Co., New Haven, Conn.
Hammacher, Schlemmer & Co., New York.
Morse Twist Drill & Mach. Co., New Bedford, Mass.
Oster Mfg. Co., Cleveland, O.
Patterson, Gottfried & Hunter, Ltd., New York.
Pratt & Whitney Co., Hartford, Conn.
Standard Tool Co., Cleveland, O.
Wells Bros. Co., Greenfield, Mass.

Telephone System
Clark Auto. Telephone Switch Board Co., Providence, R. I.

Thread Cutting Tools
Besly & Co., Chas. H., Chicago, Ill.
Oster Mfg. Co., Cleveland, O.
Pratt & Whitney Co., Hartford, Conn.
Rivett-Dock Co., Boston, Mass.

Tool Holders
Armstrong Bros. Tool Co., Chicago, Ill.
Hoggson & Pettis Mfg. Co., New Haven, Conn.
McCrosky, F. B., Cincinnati, O.
O. K. Tool Holder Co., Shelton, Conn.

Tools, Small
See Machinists' Small Tools.

Tracing Cloth
Keuffel & Esser Co., New York.
Hardtmuth, L. & C., New York.

Transmission Machinery
American Pulley Co., Phila., Pa.
Caldwell & Son Co., H. W., Chicago, Ill.
Case Mfg. Co., Columbus, O.
Cresson & Co., Geo. V., Phila., Pa.
Federal Mfg. Co., Cleveland, O.
Link-Belt Engineering Co., Philadelphia, Pa.
National Machine Tool Co., Cincinnati, O.
Patterson, Gottfried & Hunter, Ltd., New York.
Reeves Pulley Co., Columbus, Ind.

Trimmers, Wood
American Mchry. Co., Grand Rapids, Mich.
Carlin Mchry. & Supply Co., Allegheny, Pa.
Washburn Shops, Worcester, Mass.

Trolleys and Tramways
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Hunt Co., C. W., West New Brighton, N. Y.
Link Belt Engineering Co., Philadelphia, Pa.
Yale & Towne Mfg. Co., New York.

Tubing, Steel
Shelby Steel Tube Co., Pittsburgh, Pa.

Turret Machines
Automatic Mach. Co., Greenfield, Mass.
Bradford Mach. Tool Co., Cincinnati, O.
Brown & Sharpe Mfg. Co., Providence, R. I.
Bullard Mach. Tool Co., Bridgeport, Conn.
Dreses Mach. Tool Co., Cincin., O.
Flather & Co., Nashua, N. H.
Garvin Mach. Co., New York.
Gisholt Mch. Co., Madison, Wis.
Hill, Clarke & Co., Boston, Mass.
Jones & Lamson Mch. Co., Springfield, Vt.
Le Blond Mach. Tool Co., R. K., Cincinnati, O.
Lodge & Shipley Mach. Tool Co., Cincinnati, O.
Milwaukee Mach. Tool Co., Milwaukee, Wis.
Niles Tool Works Co., New York.
Pearson Mach. Co., Chicago, Ill.
Potter & Johnston Mach. Co., Pawtucket, R. I.
Warner & Swasey Co., Cleveland, Ohio.
Windsor Mach. Co., Windsor, Vt.

Turrets, Carriage
Fay & Scott, Dexter, Me.

Twist Drills
Cleveland Twist Drill Co., Cleveland, O.
Hammacher, Schlemmer & Co., New York.
Morse Twist Drill & M. Co., New Bedford, Mass.
New Process Twist Drill Co., Taunton, Mass.
Patterson, Gottfried & Hunter, Ltd., New York.
Standard Tool Co., Cleveland, O.

Universal Joints
Baush Machine Tool Co., Springfield, Mass.
Gray & Prior Mch. Co., Hartford, Conn.
Vanderbeek Tool Wks., Hartford, Conn.

Valves
See Steam Fittings.

Vises, Drill
Graham Mfg. Co., Provi., R. I.
Jacobson Mach. Mfg. Co., Warren, Pa.

Vises, Metal Workers'
Hammacher, Schlemmer & Co., New York.
Hanna, E. E., Chicago, Ill.
Howard Iron Wks., Buffalo, N. Y.
Jacobson Mach. Mfg. Co., Warren, Pa.
Parker Co., Chas., Meriden, Conn.
Reed Mfg. Co., Erie, Pa.
Walworth Mfg. Co., Boston, Mass.

Vises, Pipe
Curtis & Curtis Co., Bridgeport, Conn.
Saunders' Sons, D., Yonkers, N. Y.
Walworth Mfg. Co., Boston, Mass.

Vises, Planer and Shaper
Cincinnati Planer Co., Cincin., O.
Hendey Mach. Co., Torrington, Ct.
Pratt & Whitney Co., Hartford, Conn.

Vises, Wood Workers'
Emmert Mfg. Co., Waynesboro, Pa.
Hammacher, Schlemmer & Co., New York.
Wyman & Gordon, Worcester, Mass.

Welding Machines
Long & Allstatter Co., Hamilton, Ohio.

Wire-Drawing Machinery
Iroquois Mach. Co., New York.

Wire-Forming Machinery
Automatic Mach. Co., Bridgeport, Conn.

Wire-Straightening Machinery
Hoefer Mfg. Co., Freeport, Ill.

Worm Hobbing Machines
Pratt & Whitney Co., Hartford, Conn.

Worm Milling Machines
Cleveland Automatic Mach. Co., Cleveland, O.
Pratt & Whitney Co., Hartford, Conn.

Wrenches
Coes Wrench Co., Worcester, Mass.

Wrenches, Drop Forged
Billings & Spencer Co., Hartford, Conn.